2

## INSTALLATION RESTORATION PROGRAM

FINAL

# SITE INVESTIGATION REPORT

185 th TACTICAL FIGHTER GROUP
IOWA AIR NATIONAL GUARD
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

OCTOBER 1991

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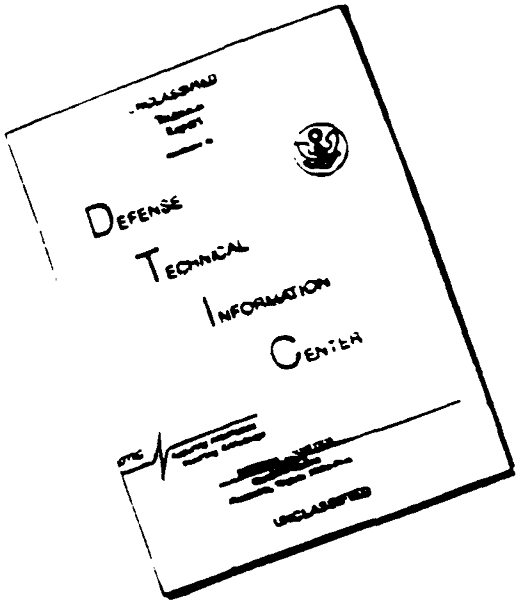
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A Site Investigation was performed on two Sites at the Iowa Air National Guard Base, Sioux Gateway Airport, Sergeant Bluff, IA to determine the presence or absence of contamination. At Site No. 1, Defueling Pit, floating hydrocarbon was found on the water table and BTEX was detected in both soils and groundwater. An Immediate Response Action has been initiated on this site and recommended for further investigation. At Site No. 2, Potential Radioactive Disposal Site, no indication of radiation was found. Levels detected at the site were below background levels and/or action levels. The site has been recommended for no further action.

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# AIR NATIONAL GUARD

# INSTALLATION RESTORATION PROGRAM
# SITE INVESTIGATION REPORT

## FINAL

**185th Tactical Fighter Group**
**Iowa Air National Guard**
**Sioux Gateway Airport**
**Sergeant Bluff, Iowa**

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**Submitted to:**

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE
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OCTOBER, 1991

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# ACRONYMS

AAS - Atomic Absorption Spectrophotometer
ANG - Air National Guard
ARAR - Applicable or Relevant and Appropriate Requirements
ASTM - American Society for Testing Materials

BAT - Best Available Technology
BCT - Best Conventional Technology
BTEX- Benzene, Toluene, Ethylbenzene, Xylenes

°C - degrees centigrade
CCC - Calibration Check Compounds
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CLP - Contract Laboratory Program

DD - Decision Document
DNR - Department of Natural Resources
DOD - Department of Defense
DOE - Department of Energy
DQO - Data Quality Objectives

EC - electrical conductivity
ES - Engineering-Science, Inc.
eV - electron volt

FS - Feasibility Study
FFS - Focused Feasibility Study

GC - gas chromatograph
GC/MS - Gas Chromatography/Mass Spectrometry

HAL - Health Advisory Limit
HSP - Health and Safety Plan
HARM - Hazard Assessment Rating Methodology
HAS - Hazard Assessment Scores
HAZWRAP - Hazardous Waste Remedial Actions Program
HMTC - Hazardous Materials Technical Center

IANG- Iowa Air National Guard
ICP - Inductively Coupled Plasma Emission Spectrometer
IRP - Installation Restoration Program

LQAC - Laboratory Quality Assurance Coordinator

MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
MSL - Mean Sea Level

## ACRONYMS (continued)

NAAQS - National Ambient Air Quality Standard
NPDES - National Pollutant Discharge and Elimination System
NBS - National Bureau of Standards
NGB - National Guard Bureau
NPL - National Priority List
NRL - Negligible Risk Level

OSHA - Office of Safety and Health Administration

PA - Preliminary Assessment
PID - Photoionization Detector
PMP - Project Management Plan
PQL - Practical Quantification Limits
PR - Percent Recovery
PRE - Preliminary Risk Evaluation
PSA - Phase-Separated Hydrocarbons

QA - Quality Assurance
QAM - Quality Assurance Manager
QAPP - Quality Assurance Project Plan
QC - Quality Control

RCRA - Resource Conservation and Recovery Act
RD - Remedial Design
RI - Remedial Investigation
RM - Remedial Measure
RPD - Relative Percent Difference
RRF - Relative Response Factors

SAP - Sampling and Analysis Plan
SARA - Superfund Amendments Reauthorization Act
SCO - Support Contractor Office
SI - Site Investigation
SOW - Statement of Work
SPCC - System Performance Calibration Compounds

TIP - photoionization detector - manufactured by Photovac
TPH - total petroleum hydrocarbons
TWWV - Total Well Water Volume

USAF - U.S. Air Force
USCS - Unified Soil Classification System
USEPA - United States Environmental Protection Agency
UST - underground storage tank

## EXECUTIVE SUMMARY

This report documents the findings and activities of the Site Investigation (SI) conducted at the Iowa Air National Guard (IANG) the Sioux Gateway Airport in Sergeant Bluff, Iowa. Field activities at the Installation took place between July 17, 1990 and August 24, 1990. This SI was conducted under the Department of Defense Installation Restoration Program. The purpose of the investigation was to confirm or deny the presence of chemical contamination in sediment and groundwater at the Base and assess potential risks to the environment and human health.

The IANG Installation is located in the west central region of Iowa, approximately seven miles south of downtown Sioux City, in Woodbury County. It is located along Interstate Route 29, just east of the Missouri River. The 185th Tactical Fighter Group operates from 92 acres of land and occupies 40 buildings at the Sioux Gateway Airport.

The Preliminary Assessment (PA) Report (Hazardous Materials Technical Center, 1988) for the IANG identified two sites that may contain hazardous materials or hazardous waste. These sites were rated according to the Hazard Assessment Rating Methodology (HARM) and recommended for further investigation.

During the SI, a total of 17 soil borings were advanced by a drilling rig. Three were completed as one-inch diameter piezometers, five as temporary wells and eight as permanent monitoring wells. One boring was abandoned after sampling. The majority of the borings were drilled to approximately 30 feet.

The unconsolidated deposits across the two sites are generally similar. The uppermost 15 feet is composed of silts and silty clays. These deposits are underlain by slightly silty fine sands. Groundwater levels range between 22 and 25 feet below grade. Groundwater flow is generally toward the southwest.

Site 1 is a former defueling pit where excess JP-4 fuel was dumped from aircraft during the period between 1961 and 1974. An estimated 180,000 gallons of

JP-4 may have been released at this site. The following are activities conducted during the SI at Site 1:

- Soil-gas survey
- Installation of three piezometers
- Installation of eight monitoring wells, including soil samples
- Sampling of soil and water at the surface of the defueling pit
- Groundwater sampling from wells without phase-separated hydrocarbons

Results of these activities showed phase-separated hydrocarbons in three monitoring wells within 200 feet of the defueling pit. The five remaining wells surrounding the pit did not have phase-separated hydrocarbons present though some dissolved concentrations of fuel components were found in two of these wells.

At Site 1, the following parameters were detected:

Volatiles
  Benzene
  Toluene
  Ethylbenzene
  Xylenes
Semi-Volatiles
  Napthalene
  2-Methylnaphthalene
  Dibenzofuran
  Pyrene
  Benzo(a)anthracene
  Chrysene
  Benzo(b)fluoranthene
  2,4-Dimethylphenol
Total Petroleum Hydrocarbons
  Gross Alpha
  Radium 226
  Radium 228

All of these parameters except for the radiological parameters were detected within about 170 feet of the defueling pit. Analysis for radiological parameters were performed from only one location about 375 feet north of the defueling pit.

The volatiles (BTEX) were detected in soil and water and their concentrations ranged from non-detect to 100,000 (estimated) ppb. Semi-volatiles were detected in soil and water and their concentrations ranged from non-detect to 2,900 ppb. Total petroleum hydrocarbons concentrations in soil and water ranged

from non-detect to 3,100 ppm and concentrations of radiological parameters ranged from non-detect to 35.6 pCi/l. A potential migration path for the contaminants could be with the groundwater.

Iowa Action Levels for BTEX in groundwater range from 1 ppb for benzene to 10,000 for total xylenes. No enforceable MCLs for BTEX in soil are in effect. Also, there are no enforceable MCLs in effect for semi-volatiles or Total Petroleum Hydrocarbons. MCLs of 15 pCi/l for Gross Alpha and 5 pCi/l for combined Radium 226 and 228 are in effect.

Based on these results, a focused feasibility study with remedial measures is recommended. According to the preliminary risk evaluation (PRE), there is no immediate threat to persons in the area. However, remedial measures should be implemented so that the migration of the free and dissolved hydrocarbons can be checked.

Site 2 is the possible low-level radioactive waste disposal area. This site is a small area ten feet by ten feet enclosed by a dilapidated barbed-wire fence. Inside the fence are three metal casings. It is our understanding that this area was used by the Air Force for the disposal of low-level radioactive wastes, such as radio tubes. The following activities were conducted at the site during the SI:

- Surface radioactivity survey
- Magnetometer survey
- Installation of five temporary monitoring wells
- Collection of soil and groundwater samples for radioactivity analyses
- Removal of temporary wells.

At Site 2, the following parameters were detected:

Gross Alpha
Gross Beta
Radium 226
Radium 228

These concentrations ranged from non-detect to 45 pCi/l in the soil and groundwater. These parameters were detected as far as 160 feet away.

Results of analyses for gross radioactivity and radium showed the following concentrations in the soil at Site 2 to range from 0.9 pCi/g to 3.3 pCi/g for gross

alpha; from 1.3 pCi/g to 5.3 pCi/g for gross beta; from 0.36 pCi/g to 1.5 pCi/g for radium 222 and from less than 0.2 pCi/g to 2.4 pCi/g for radium 228. None of these concentrations exceeded the MCL. In addition, these concentration levels do fall within expected ranges according to the Controls for Environmental Pollution Laboratory (Pers. Comm. J. Mueller, CEP, 1990). The analysis of Missouri River silt samples detected gross alpha concentrations at 2 pCi/g and non-detect while gross beta levels were 4 pCi/g and 0.02 pCi/g (Pers. Comm. T. Kastamzo, Fort Calhoun Nuclear Power Plant, 1990). Values in Nazaroff (1988) for radium 226 and thorium 232, the parent of radium 228, range from 0.11 pCi/g to 4.19 pCi/g for soils in the United States.

Groundwater samples from three of the five wells from Site 2 exceeded the gross alpha MCL. However, radium concentrations in water can range from 19 pCi/l to 180,000 pCi/l depending upon the local geologic conditions (Nazaroff, 1988).

Samples from MW-6 and an UST assessment location were taken for background purposes with the following results:

soil samples collected from monitoring well 6 at Site 1 (located cross-gradient and approximately 3,500 feet east of Site 2) showed gross alpha concentration to be 35 pCi/g for a sample collected at 23 feet and 1.4 pCi/g for a sample collected at 27 feet (The high value of 35 pCi/g is considered an anomaly, since it was not confirmed by the sample below. The value could have been caused by minerals such as biotite or feldspar). Soil samples from a monitoring well installed for an underground storage tank assessment, located approximately one mile east of Site 2, had gross alpha concentrations of 1.2 pCi/g and 1.6 pCi/g. A water sample from monitoring well 6 had a gross alpha concentration of 21 pci/l and the value from the well at the underground storage tank was 25 pCi/l.

The results of the analyses performed on soil and water samples collected from Site 2 (when compared to the background data collected and data available from literature) suggest that the values are within the range of naturally occurring conditions and not a result of Air Force or Air National Guard activities.

It is recommended that a decision document elimination Site 2 from further investigation be prepared along with the available data.

# SECTION 1

# INTRODUCTION

## 1.1 BACKGROUND AND AUTHORITY

The Department of Defense (DOD) has developed the Installation Restoration Program (IRP) to identify and fully evaluate suspected problems associated with past contamination, and to control potential health, welfare and environmental hazards resulting from these past operations. The IRP is the basis for response action on ANG installations under the provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 and amended by the Superfund Amendment and Reauthorization Act (SARA) of 1987. This is the primary legislation governing remedial action at past hazardous waste disposal sites.

The National Guard Bureau (NGB), through the Air National Guard (ANG) Support Center, has initiated the IRP in response to policies of the Department of Defense (DOD). The IRP has been developed as a phased program for identifying and addressing environmental contamination resulting from past management practices at ANGB installation. As a part of the IRP, the ANG through a U.S. Air Force (USAF) interagency technical support agreement with the U.S. Department of Energy (DOE), uses Martin Marietta Energy Systems, Inc. (MMES) to provide technical assistance for implementation of the ANG IRP. MMES has been contracted by DOE to carry out the Hazardous Waste Remedial Actions Program (HAZWRAP) at Air National Guard. Engineering-Science (ES) as a subcontractor to HAZWRAP conducted a Site Investigation (SI) at the IANG at the Sioux Gateway Airport in Sergeant Bluff, Iowa. Authorization for the investigation is by General Order No. 96B-99788C, Task Order No. Y-03.

## 1.2 PURPOSE AND SCOPE

The objective of the SI is to evaluate two identified sites at the Installation and determine whether (1) a Remedial Investigation (RI) is required, (2) a decision of no further action can be supported, (3) a Focused Feasibility Study/Remedial Measure (FFS/RM) is required, or (4) immediate removal is appropriate.

This report documents activities and findings of the SI. The purpose of the SI is to confirm the presence or absence of contamination in soils and groundwater and assess the potential risks to health, welfare and the environment.

Section 6 of this report contains recommendations based on the results of the SI. The recommendations can be divided into two categories: Those indicating further action in the remedial investigation (RI) and those indicating no further action. The purpose of the RI is to define the extent and magnitude of contamination detected in the SI and to further assess potential risks to health, welfare and the environment.

## 1.3 INSTALLATION DESCRIPTION AND HISTORY

The 185th Tactical Fighter Group was first organized in December, 1946. First known as the 174th Fighter Squadron, the unit was reorganized and designated the 185th Tactical Fighter Group in 1962. The 185th operates from 92 acres of land at the Sioux Gateway Airport and occupies 40 buildings. The Installation had steady growth of personnel from time of its organization until the present time. The majority of building construction took place in the mid to late 1950's and in the mid-1970's.

The present property agreement is between the City of Sioux City, Iowa and the Department of the Air Force (License for National Guard Purposes, Form 1 May 63). The agreement commenced 1 July 1969 and expires 20 June 2019. The agreement automatically renews annually until the expiration date, unless the Government exercises its right to give notice to termination. The agreement provides for the exclusive use of buildings and parcels of land located on the Sioux Gateway Airport, together with all roads, sidewalks, railroads, utilities, drainage ditches, sewer lines, aprons, buildings and structures and tools, equipment and fixtures, on 11 parcels which are lettered and listed within the agreement.

Use and occupancy of the Installation is without cost to the Government, provided the Government maintains and keeps the premises in good repair and condition, and pays all cost of operations, maintenance and restoration caused by the occupancy of the premises. The Government reserves the right to use the property included in the license, including all buildings and improvements situated thereon, for such purposes as the Department of the Air Force deems necessary in the interest of national defense.

During the period from 1968 to 1988, at least 16 shops generating various hazardous wastes were in operation at the IANG Installation (HMTC, 1988). These shops included Aircraft Maintenance, Aerospace Ground Equiopment Maintenance, Fuels Maintenance, Entomology, Vehicle Maintenance, Nondestructive Inspection, Weapons Maintenance, Corrosion Control, Paint Shops, Machine Shop, Hangar Spaces, Plumbing Shop, Electric Shop, Battery Shop, PhotoLab and Propulsion Shop.

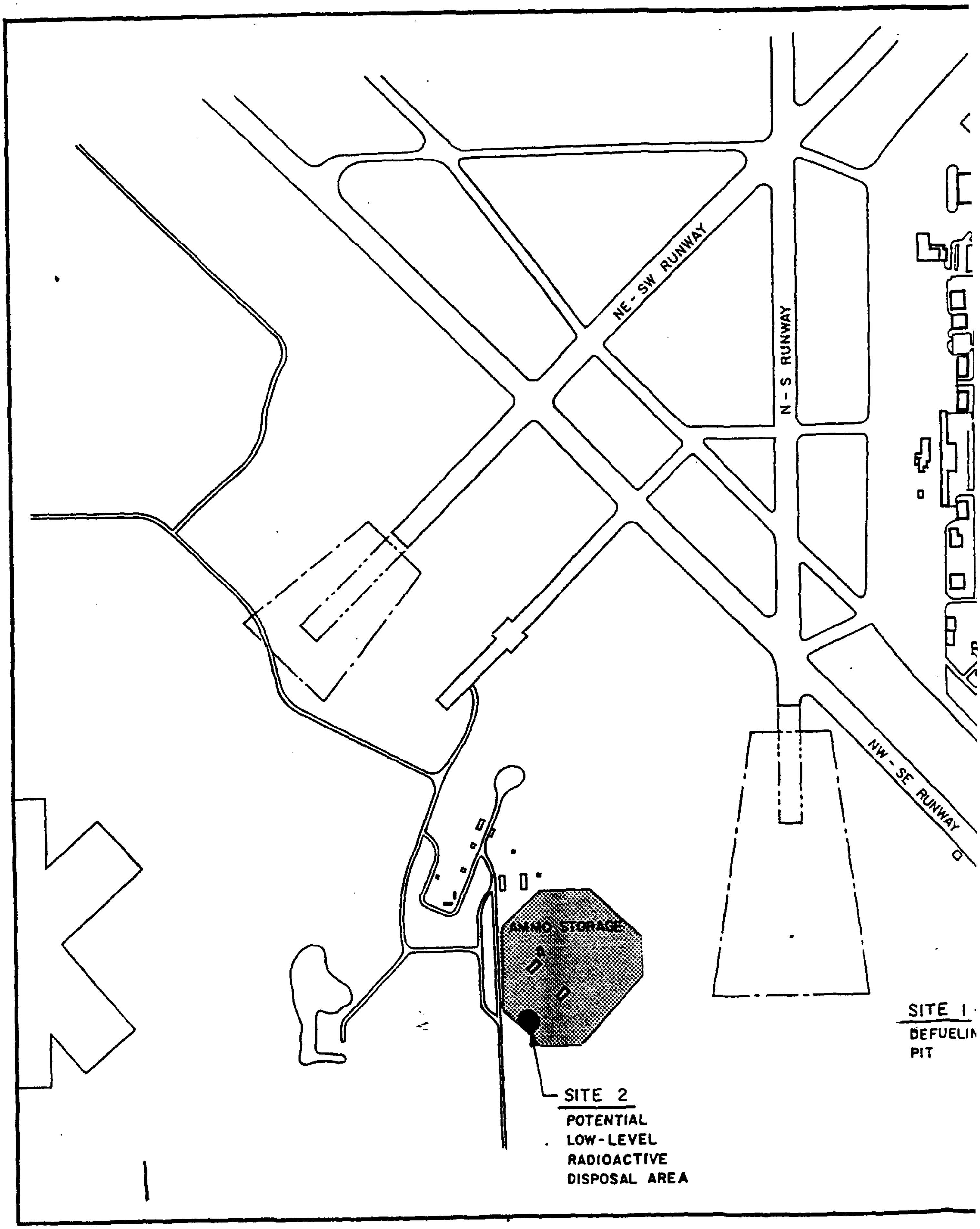
A Preliminary Assessment (PA) conducted in 1988 by the Hazardous Materials Technical Center (HMTC) identified two sites which warranted further investigation.

## 1.4 SUMMARY OF PREVIOUS ACTIVITIES AND FACILITY DESCRIPTION

One prior investigation was conducted on the Installation. A PA, dated December 1988 was conducted to identify and evaluate suspected problems associated with past hazardous waste handling procedures, disposal sites, and spill sites on the Installation. Personnel from HMTC visited the site, reviewed existing environmental information, analyzed Installation records and conducted interviews with past and present Installation personnel. Based on information developed during the PA, two sites were identified that may contain hazardous materials or hazardous wastes (HMTC, 1988). Specific information identified in the PA is summarized below.

A defueling pit was identified in the PA as Site 1 (Figures 1.1 and 1.2). This defueling pit exists in a slight depression two to three feet deep and is located off the edge of the runway near the Alert Hangar (Building No. 241). The pit was used to dump excess JP-4 fuel approximately twice per month during the period 1961 to 1976. An estimated 180,000 gallons of JP-4 may have been released at this site. In June of 1989, the dimensions of the pit were approximately 30 feet by 20 feet and contained ponded water. Vegetation around the pit did not appear stressed at the time of this inspection. An uncapped metal pipe located at the pit center measures about four inches in diameter and protrudes about three feet from the surface.

Site 2 is the possible low-level radioactive waste disposal area (Figures 1.1 and 1.3). It is located inside the ammunition storage area on the west side of the Installation. Site 2 is a small area of high grasses approximately ten feet by ten feet enclosed by a low, dilapidated barbed wire fence. Within the enclosed area are three neatly installed steel casings, two of which are installed with concrete pads at their bases.


NE - SW RUNWAY
N - S RUNWAY
NW - SE RUNWAY
AMMO STORAGE
SITE 1
DEFUELIN
PIT
SITE 2
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LOW-LEVEL
RADIOACTIVE
DISPOSAL AREA

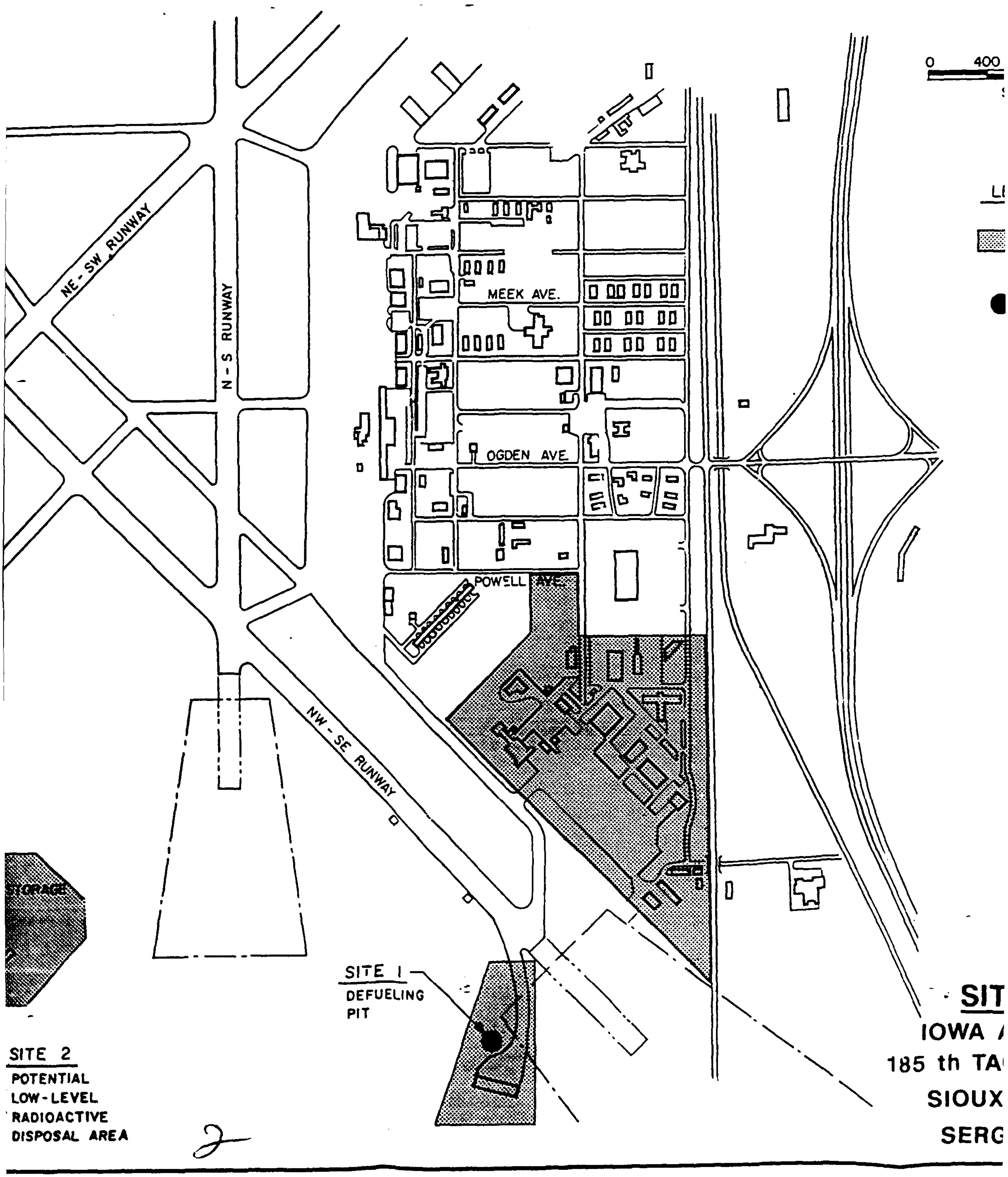
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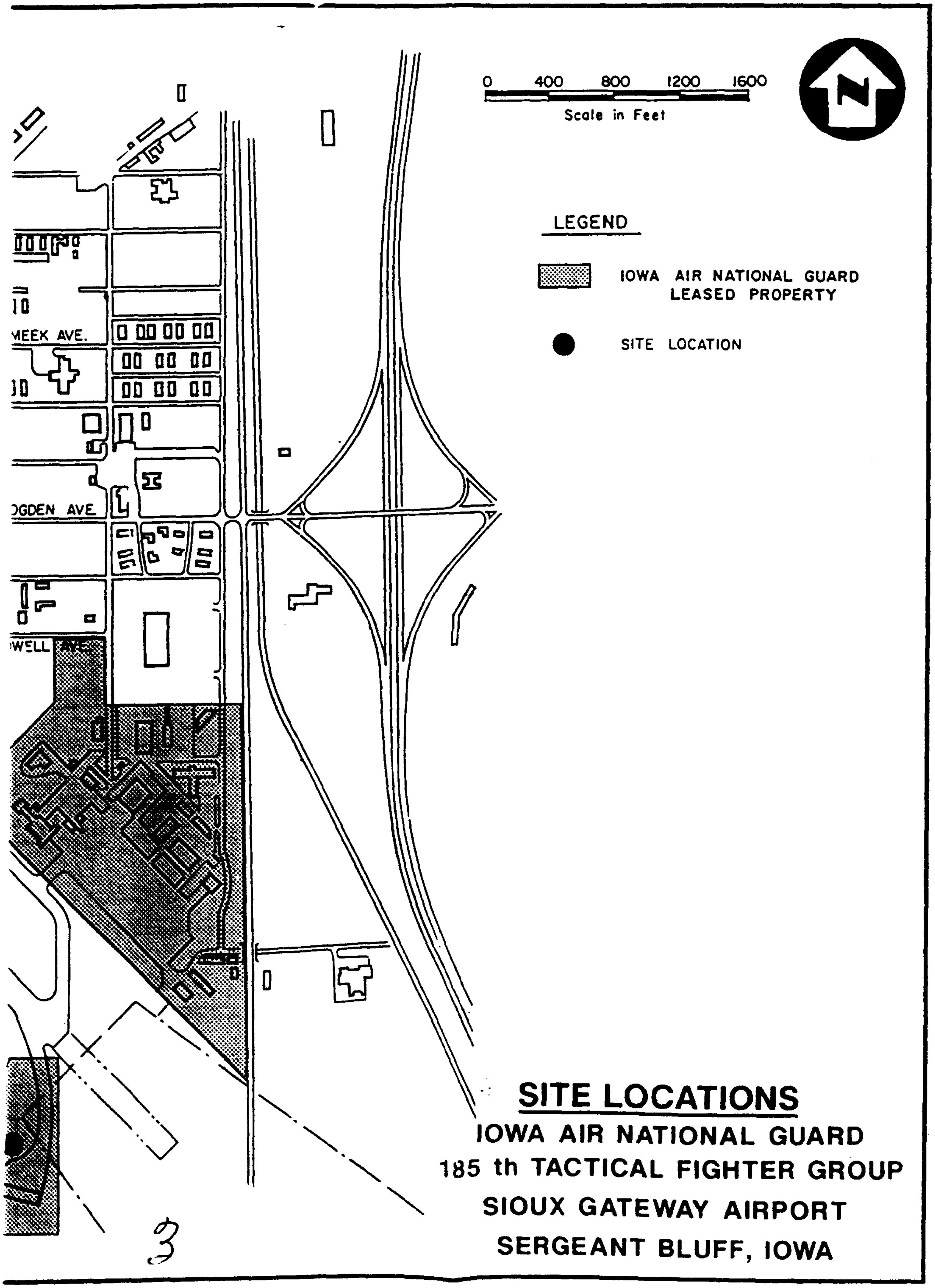
FIGURE 1.1



## SITE LOCATIONS

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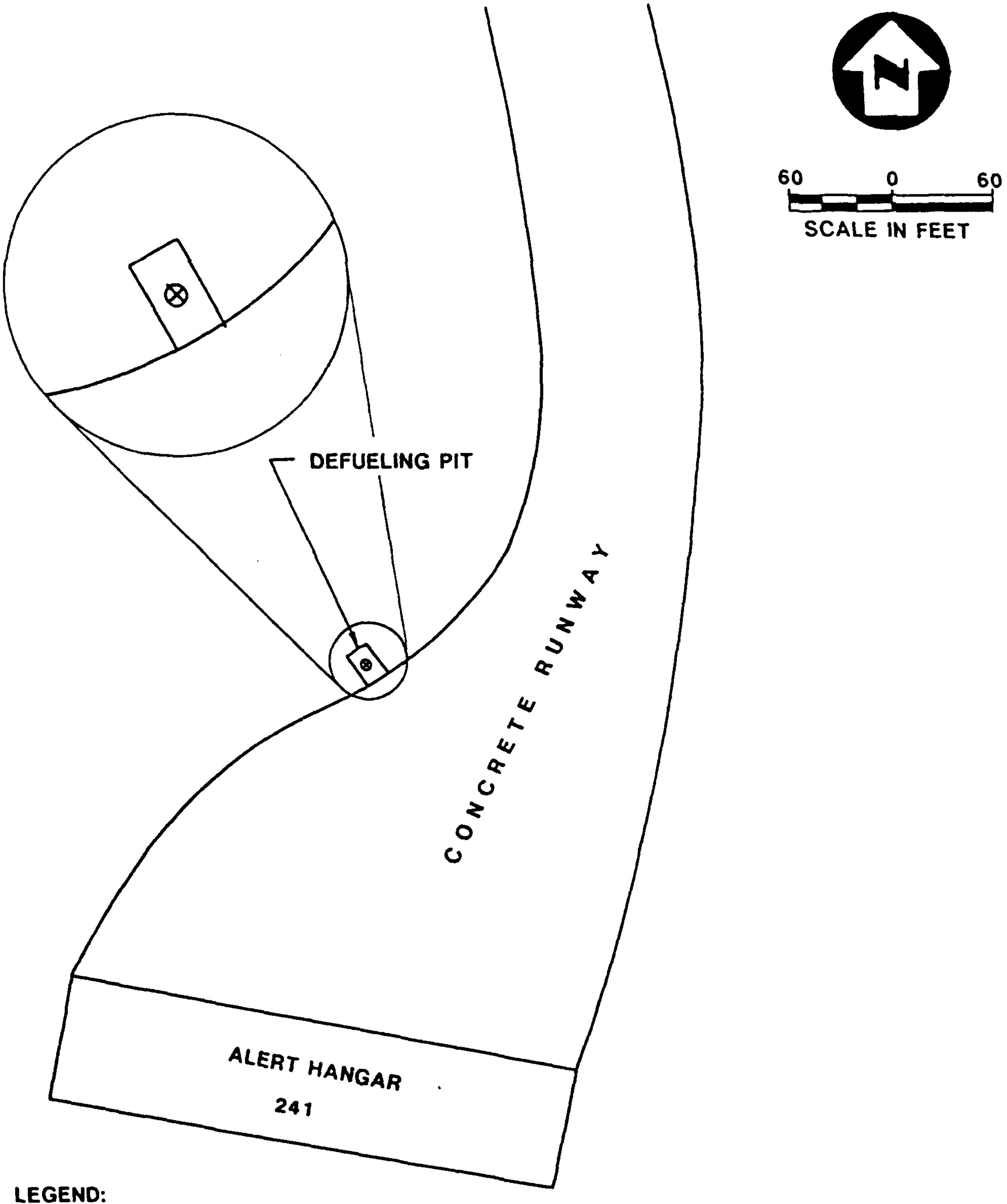
FIGURE 1.2



## GENERAL SITE PLAN

SITE 1: DEFUELING PIT
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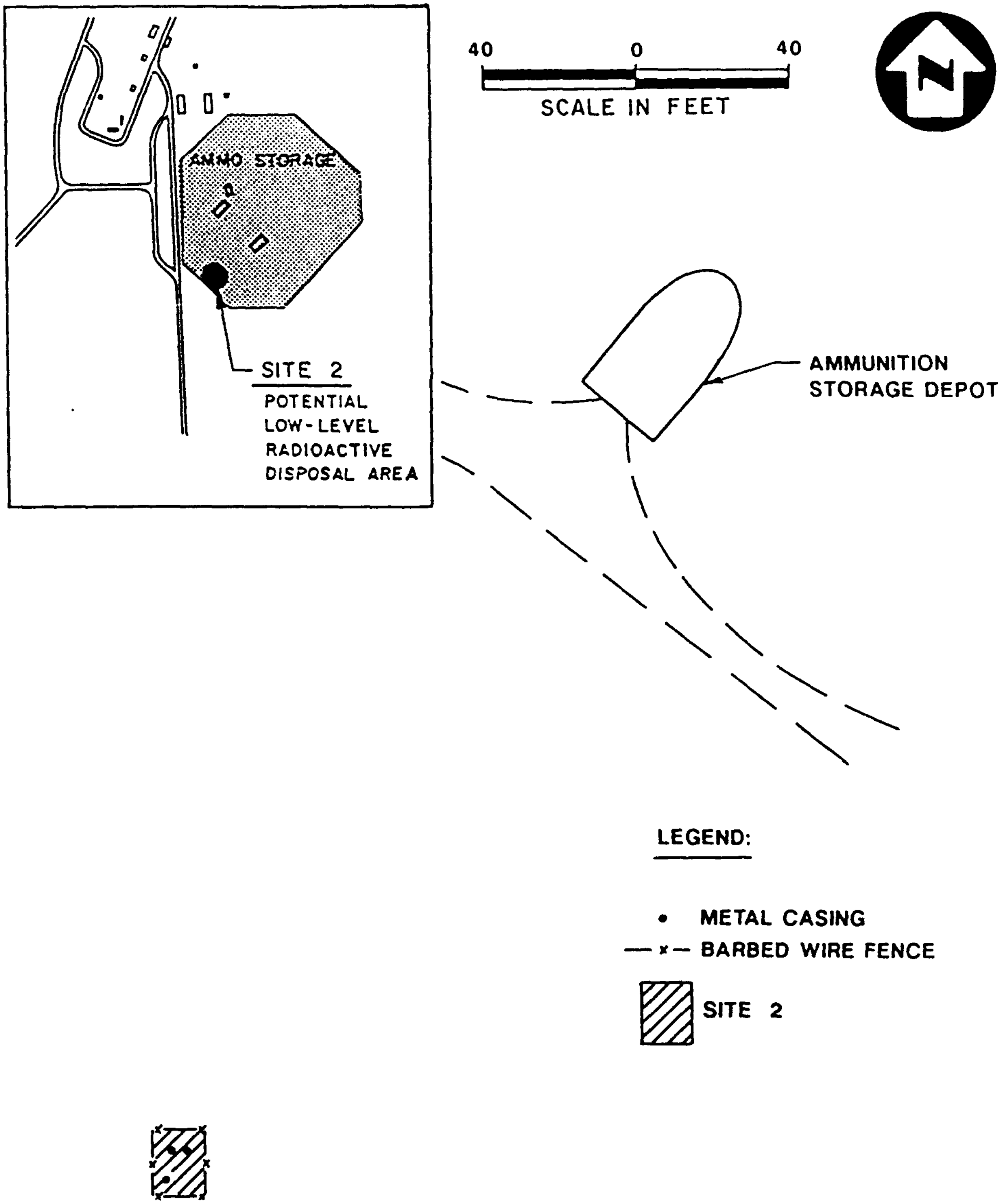
FIGURE 1.3



## SITE PLAN

### SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

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All three have locked lids. It was reported that this area was used by the Air Force for disposal of low-level radioactive wastes, such as radio tubes. Additional information on the amounts and types of wastes disposed of at this site is not available. During inspections for the PA, no radioactivity was detected by a Geiger counter in the vicinity of the fenced area, though readings were not taken on the inside of the casings. There was no evidence of environmental stress at this location.

# SECTION 2

# ENVIRONMENTAL SETTING

## 2.1 GEOGRAPHIC SETTING

The 185th Tactical Fighter Group (TFG) of the IANG is located at the Sioux Gateway Airport, Sergeant Bluff, Iowa. The Sioux Gateway Airport is located in the west central region of Iowa, approximately seven miles south of downtown Sioux City, in Woodbury County. The Installation is located in Township 88 North, Range 47 West in Sections 25 and 36. The Installation presently leases a total of 92 acres in eleven separate parcels on the eastern part of the airport from the City of Sioux City, Iowa. Figure 2.1 shows the location of the Installation relative to the State of Iowa.

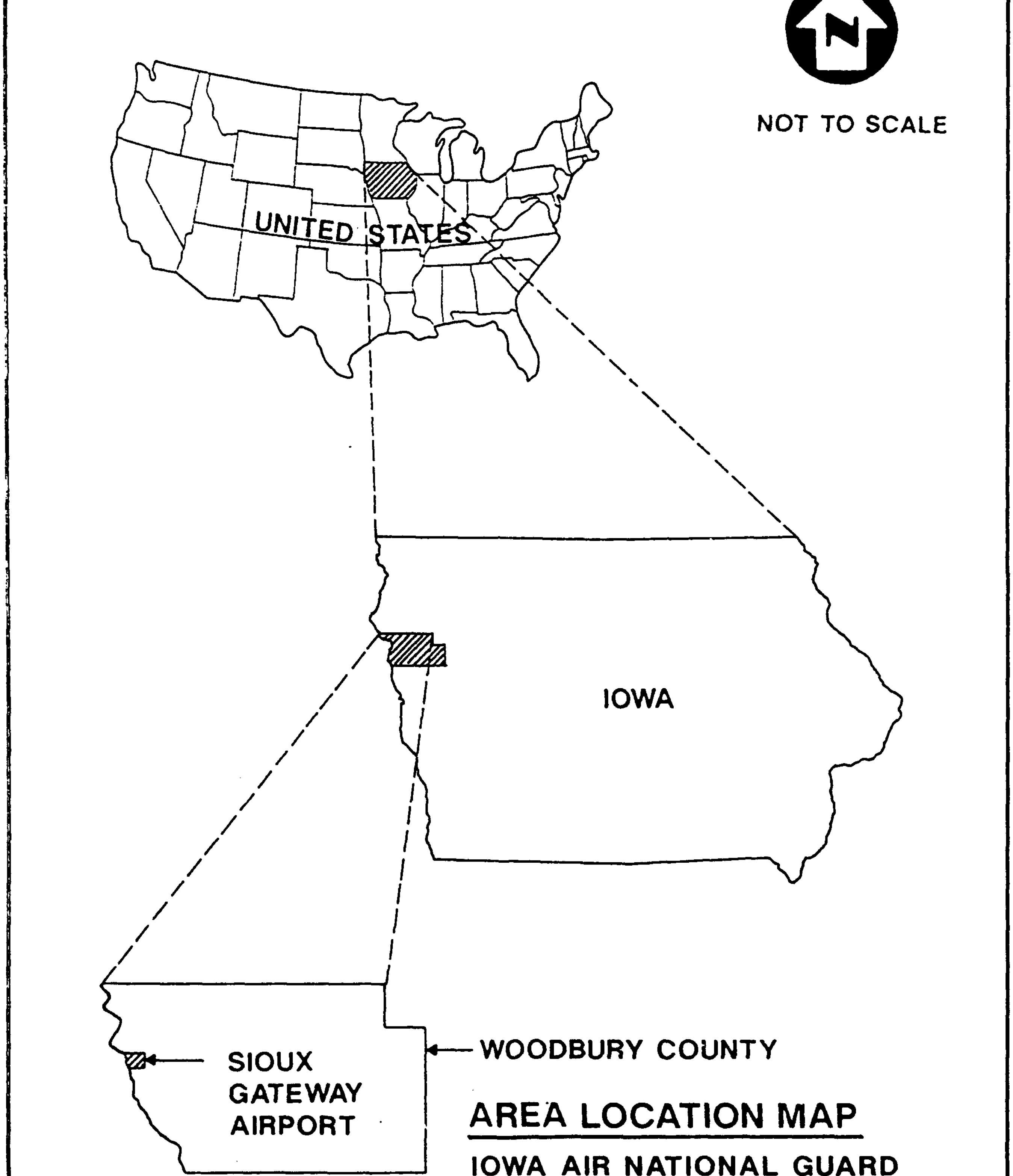
Land located north of the Installation includes the former Sioux City Air Force Base, which is now a mixture of commercial and residential property. West of the Installation are the airport runways and the Missouri River. The Missouri River is approximately 2 miles from the Installation. Properties located south and east of the Installation are primarily agricultural and residential. Approximately 0.75 miles northeast of the Installation is the residential community of Sergeant Bluff, Iowa. The residential population within a 1-mile radius of the Installation, including Installation personnel is estimated at 1,810 (HMTC, 1988).

## 2.2 CLIMATE

The climate of the Sioux City, Iowa area is described as typical of interior continental locations. It is characterized by relatively light rainfall, lower humidity, hot summers, cold winters and wide variations in temperature and precipitation from year to year. The average annual temperature for the northern counties of Iowa is 46°F. The coldest month is January and the warmest month is July with average temperatures of 19°F and 73°F, respectively (National Oceanic and Atmospheric Administration, 1974).

The mean annual precipitation in the Sioux City area is 25 inches per year. Approximately 75 percent of annual precipitation falls as rain during the warmer months of April to September. Floods are most frequent in June, but also occur at the end of

FIGURE 2.1



AREA LOCATION MAP

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March usually as a consequence of rain on frozen ground or rain and rapid snowmelt (HMTC, 1988).

## 2.3 GEOLOGY

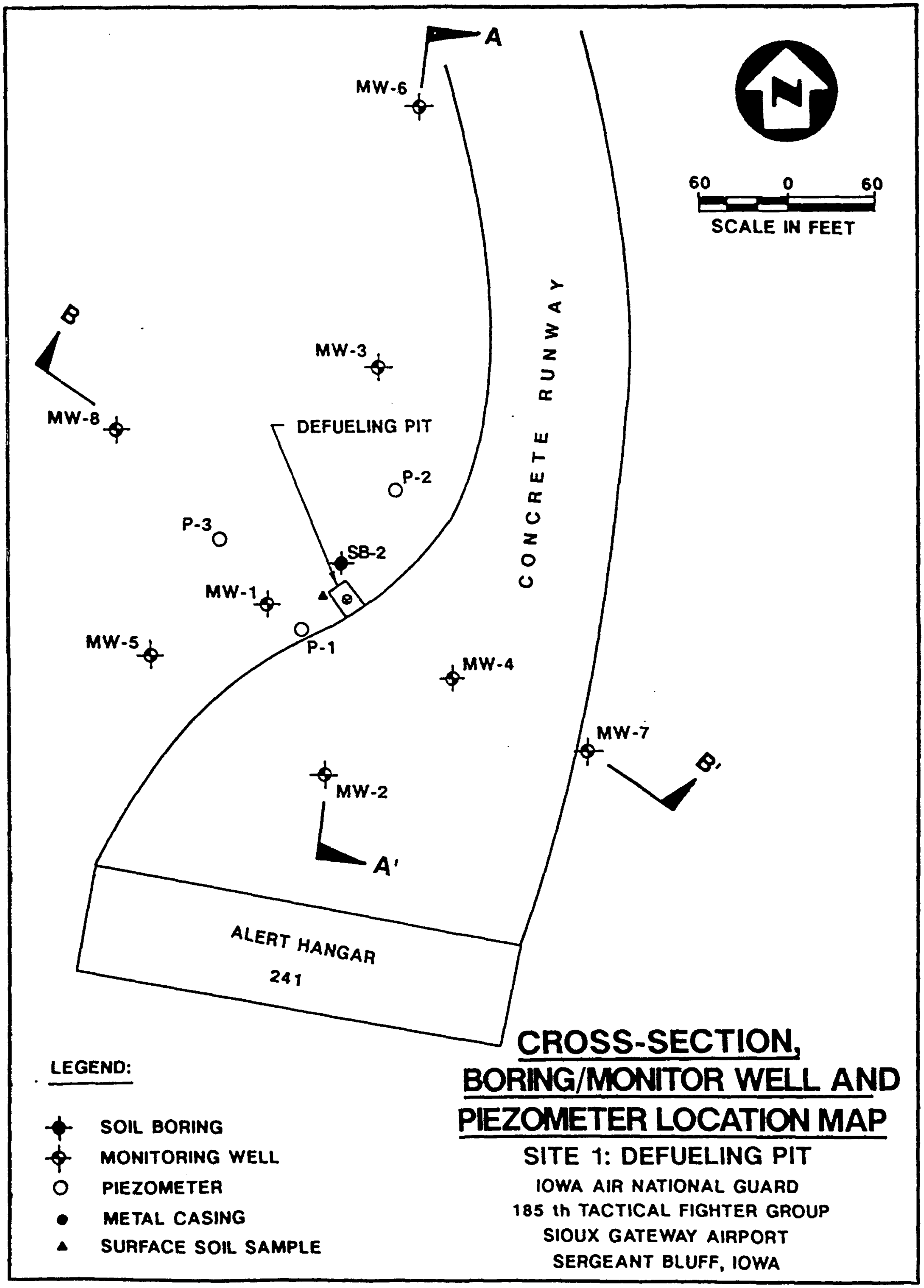
The Installation is located approximately two miles east of the Missouri river within the Missouri Alluvial Plain Physiographic Province. The alluvial sediment consists of unconsolidated clay, silt, sand and gravel and was deposited by Pleistocene glacial meltwater (Munter, et al., 1983). According to well logs from the vicinity of Sergeant Bluff, Iowa, the thickness of the unconsolidated deposits range between 110 and 210 feet.

At Site 1 (Defueling Pit) (Figure 2.2), the sediments encountered are generally composed of silty clays and silty fine sand. The stratigraphy showed silty clays occurring between zero and 15 feet and silty sand between 15 and 30 feet below grade. At Site 2 (Figure 2.3) (potential radioactive waste disposal area) which lies approximately 3200 feet northwest of Site 1, sediments encountered were interbedded silts fine sands and clays between zero and 16 feet. Between 16 and 32 feet below grade, silty fine sand was typical. Figures 2.4 and 2.5 show general geologic cross-sections across Sites 1 and 2.

The bedrock beneath the Missouri Alluvial Plain consists of Cretaceous age rocks that dip toward the northwest at approximately four feet per mile. The first bedrock encountered beneath the unconsolidated deposits is the Nishnabotna member of the Dakota Formation. The Nishnabotna member is a medium to coarse grained, micaceous sandstone. It often contains conglomerate, shale, claystone, and fine-grained sandstone interbeds. The thickness of the Nishnabotna member varies from 63 to 365 feet with an undulating surface (Munter, et al., 1983).

The Cretaceous rocks are unconformably underlain by Paleozoic rock in the area of the Installation. These Paleozoic rocks consist of dolostones, limestones, and sandstones which dip to the south-southeast at 18 feet per mile. The first Paleozoic rocks found beneath the Installation is an undifferentiated limestone and dolostone formation of Mississippian-age. This rock unit is underlain by Devonian, Ordovician, and Cambrian-age rock (see Table 2.1).

FIGURE 2.2



# CROSS-SECTION, BORING/MONITOR WELL AND PIEZOMETER LOCATION MAP

## SITE 1: DEFUELING PIT

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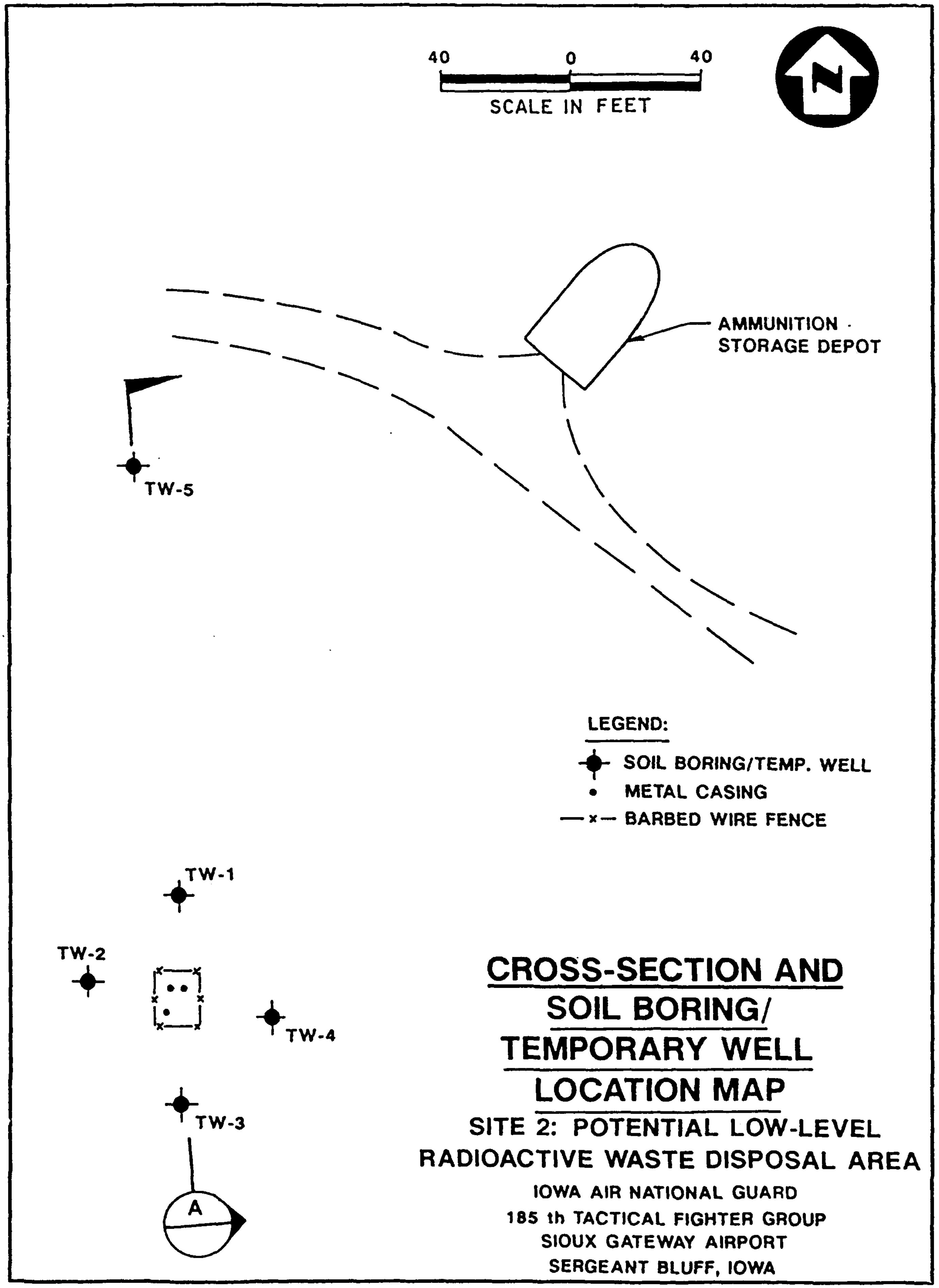
FIGURE 2.3



## CROSS-SECTION AND SOIL BORING/ TEMPORARY WELL LOCATION MAP

SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

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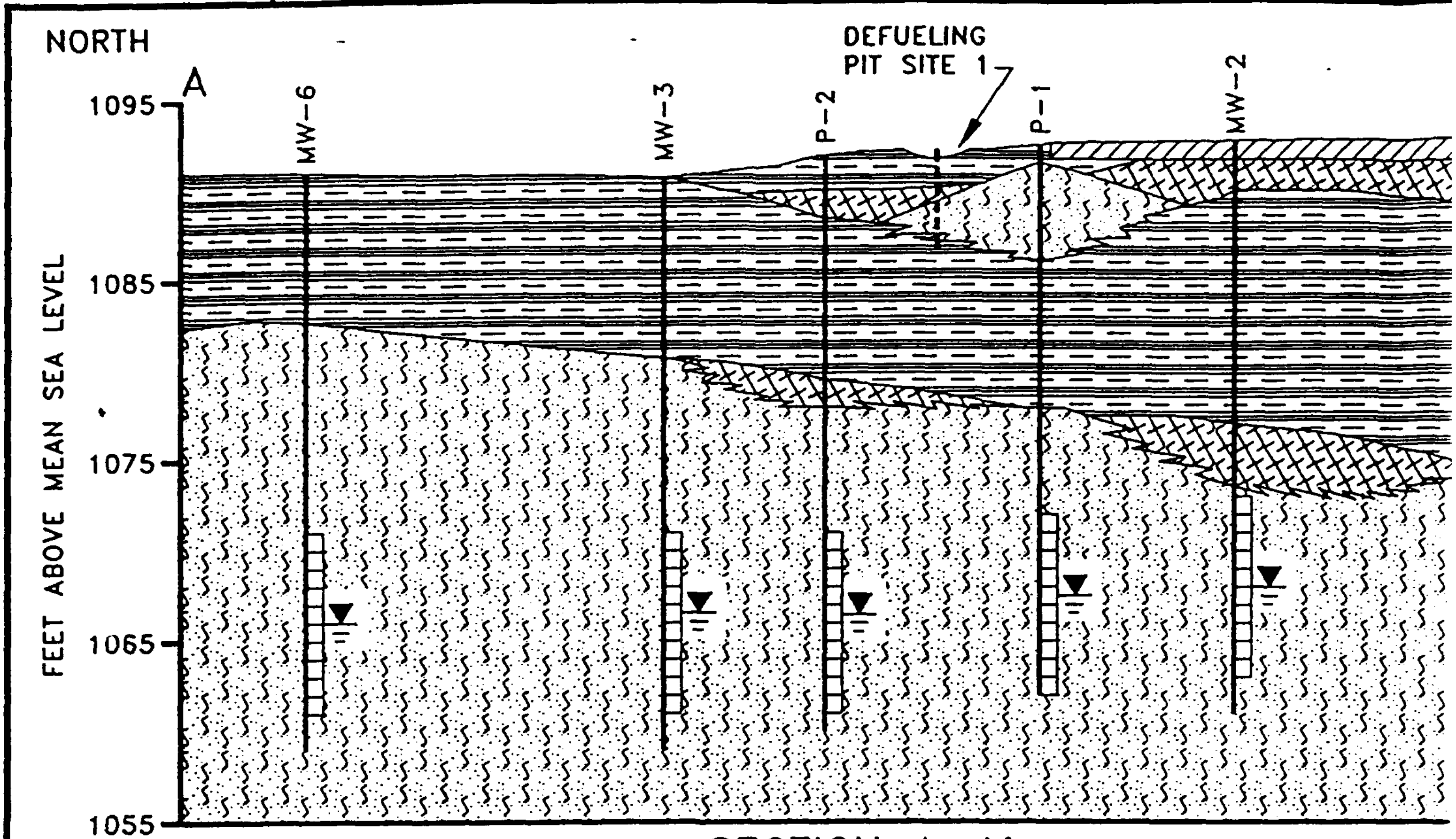
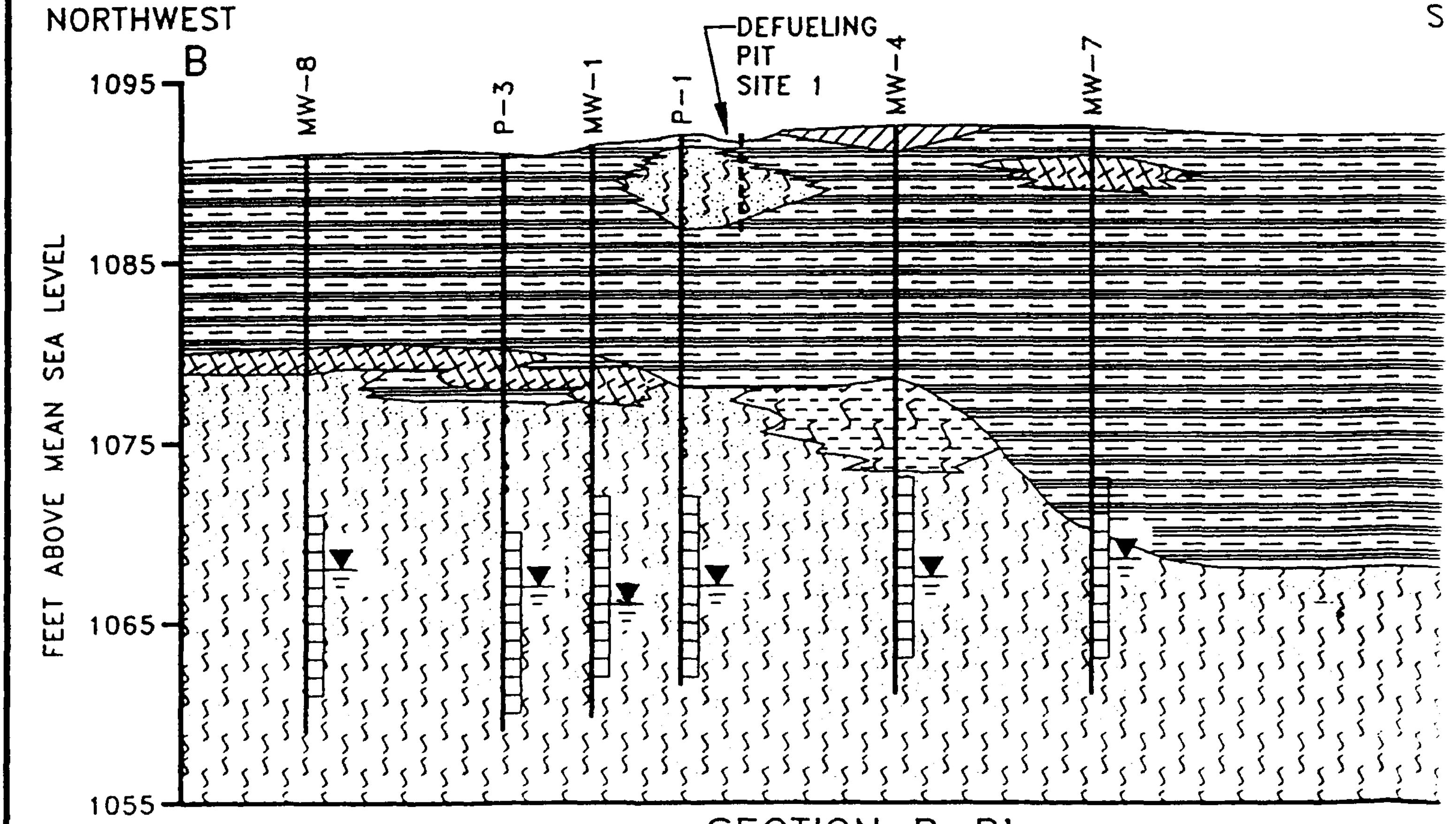


SECTION A-A'



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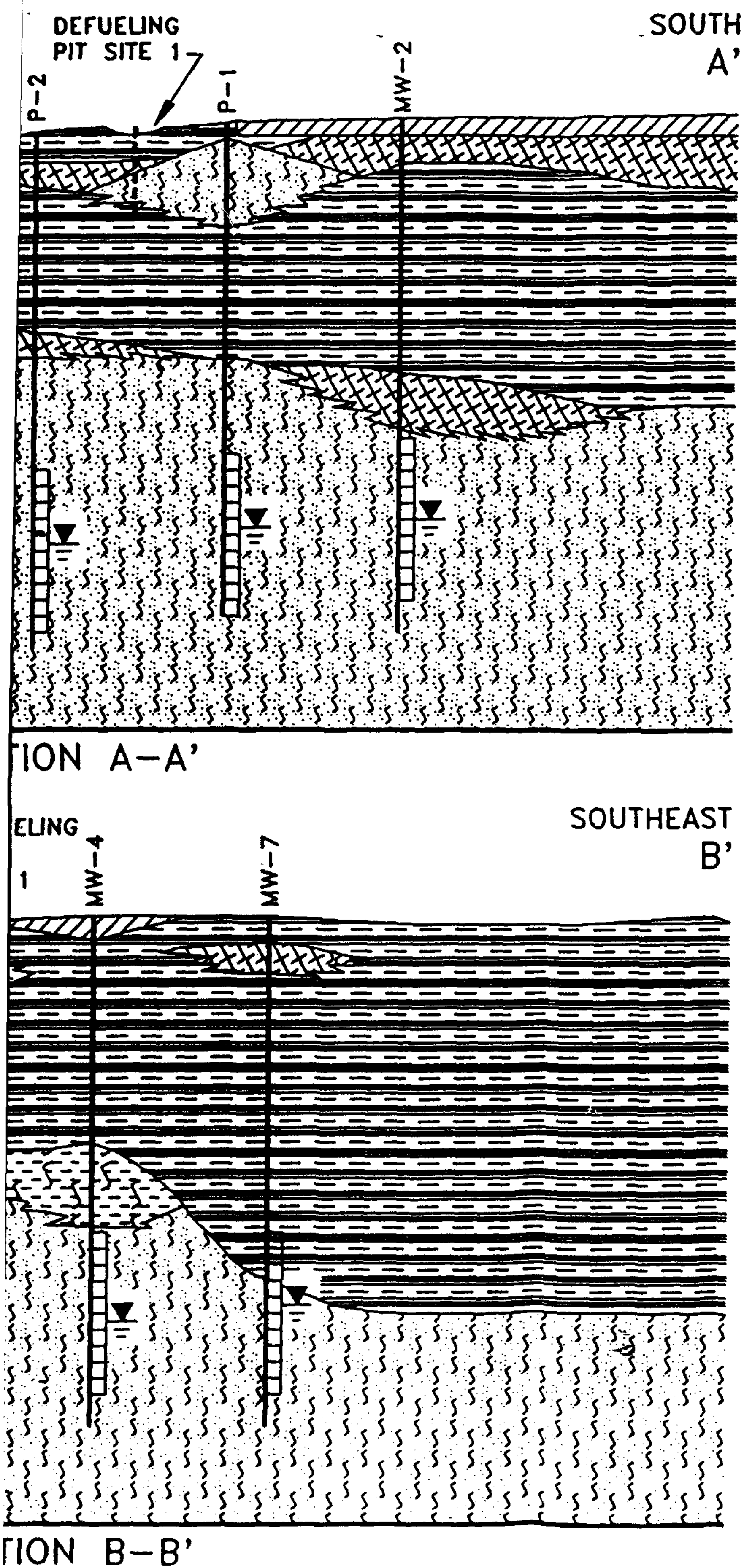

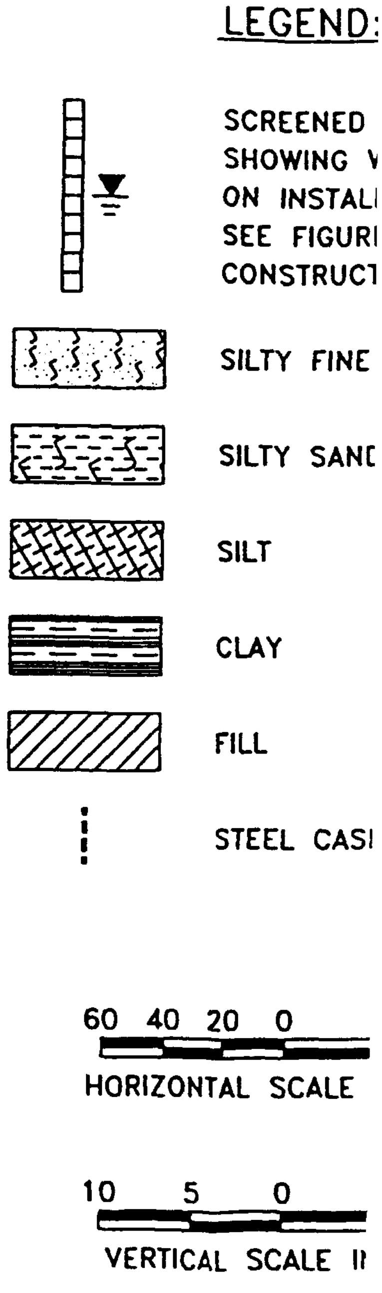

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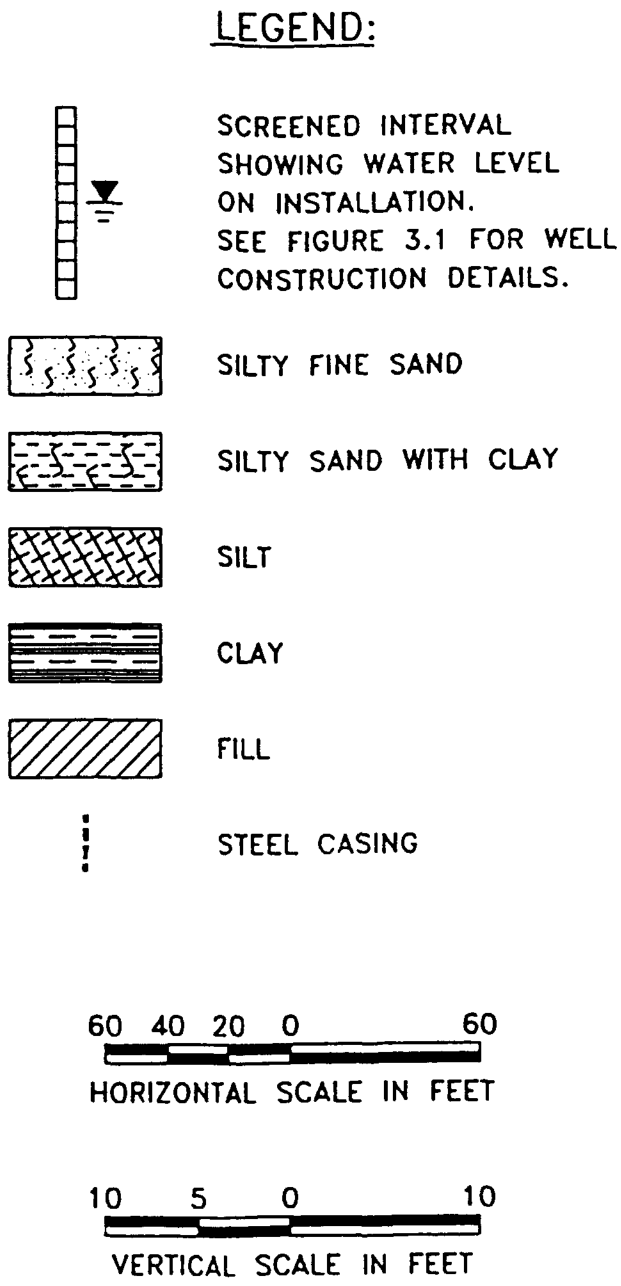
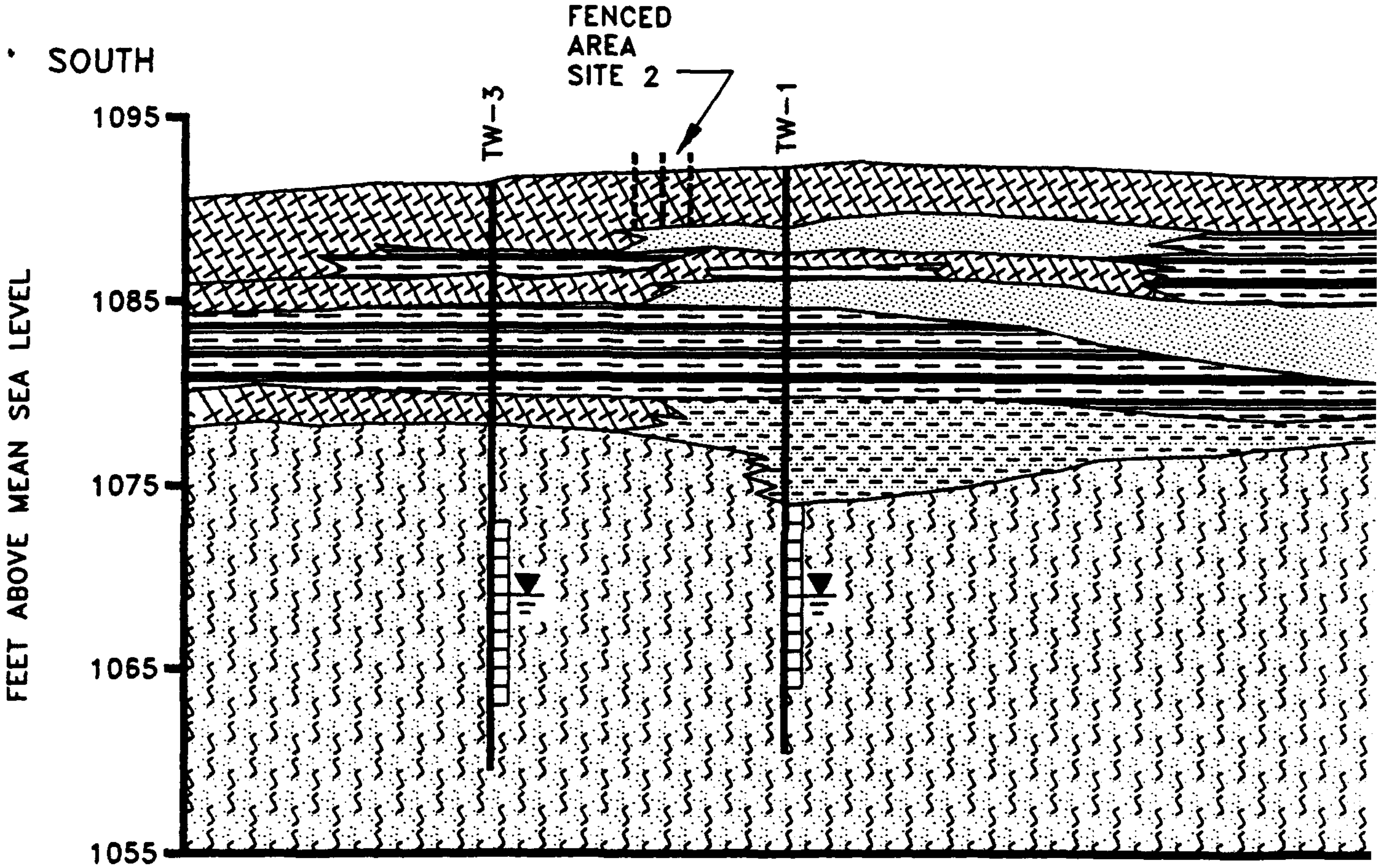
FIGURE 2.4



GENERALIZED GEOLOGIC CROSS SECTIONS

DEFUELING PIT AREA

*IOWA AIR NATIONAL GUARD*
*185TH TACTICAL FIGHTER GROUP*
*SIOUX GATEWAY AIRPORT*
*SERGEANT BLUFF, IOWA*



SECTION A-A'

0380002

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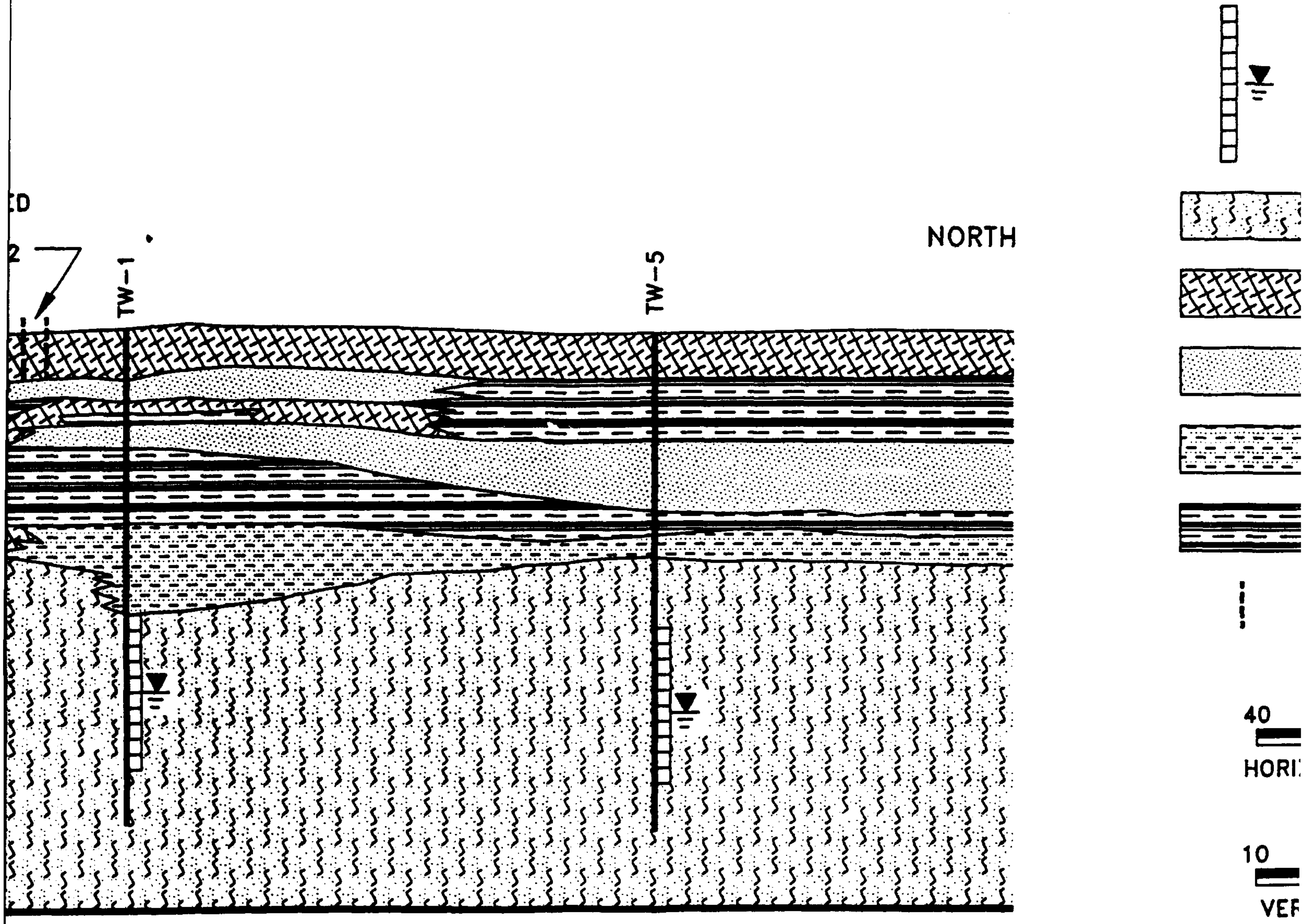

SECTION A–A'

# GENERALIZED GEOLO
SITE 2 P
RADIOACTIVE W.

*IOWA .*
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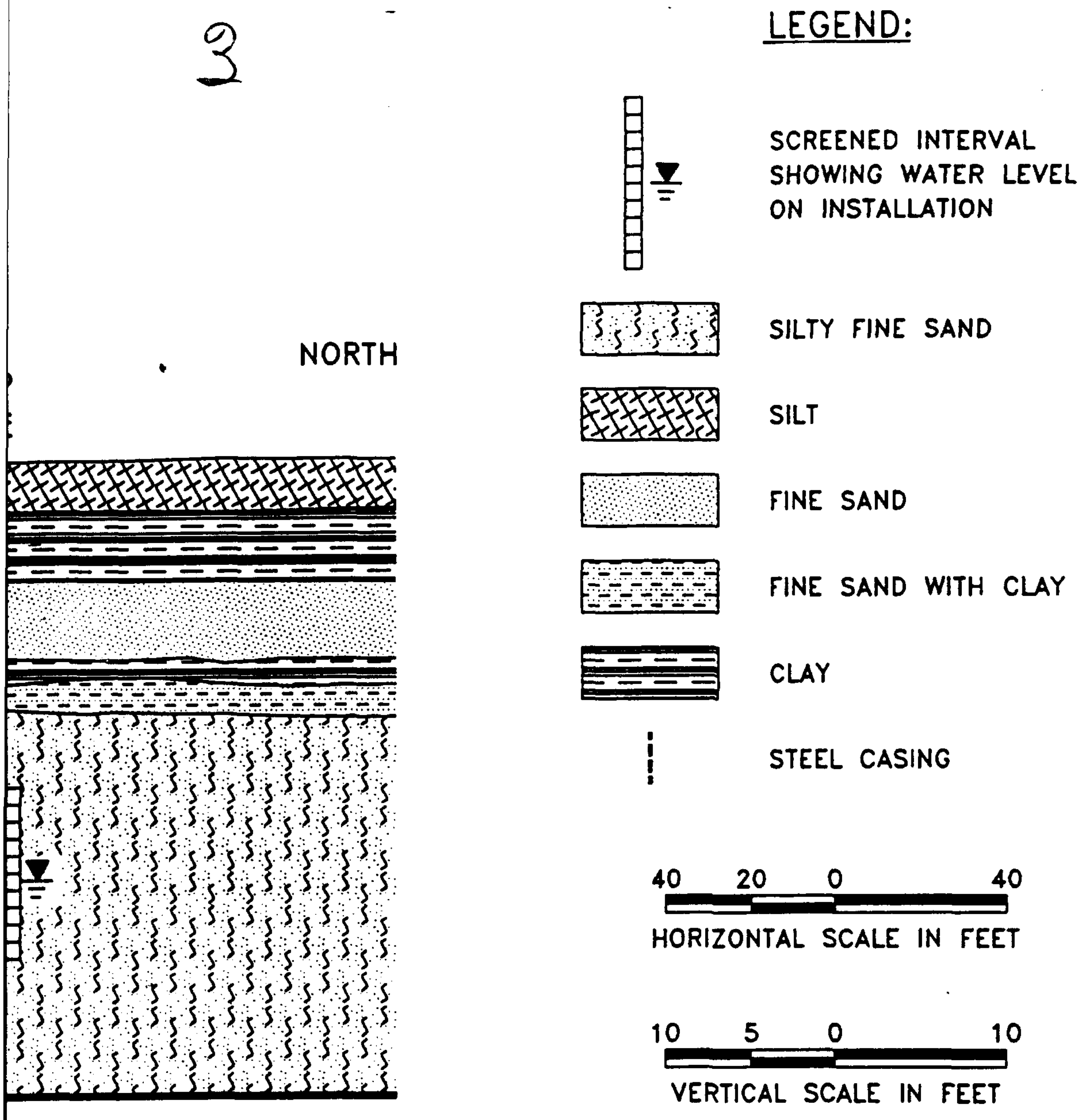


# GENERALIZED GEOLOGIC CROSS SECTIONS

## SITE 2 POTENTIAL LOW LEVEL RADIOACTIVE WASTE DISPOSAL AREA

*IOWA AIR NATIONAL GUARD*
*185TH TACTICAL FIGHTER GROUP*
*SIOUX GATEWAY AIRPORT*
*SERGEANT BLUFF, IOWA*

HYDROGEOLOGIC UNITS
IN NORTHWEST IOWA,
(MUNTER, 1983)

TABLE 2.1

| Era | System | Formation | Description | Hydrostratigraphic unit |
|---|---|---|---|---|
| Cenozoic | Quaternary | undifferentiated | sand and gravel near streams | alluvial aquifers |
| | | | loess, wind blown silt mantling uplands and terraces | minor aquifers grading to leaky confining unit |
| | | | till, poorly sorted fine-textured glacial sediment | regional confining unit commonly 200-400 feet thick |
| | | | sand or sand and gravel within or between tills or beneath tills in bedrock valleys. | intertill or buried channel aquifers, locally highly productive. |
| Mesozoic | Cretaceous | Carlile | calcareous black marine shale | regional confining beds, where present. Weathered Greenhorn may yield small amounts of water. |
| | | Greenhorn | chalky limestone, shaly | |
| | | Graneros | calcareous marine shale | |
| | | Dakota<br>Woodbury Member | interbedded shale, sandstone and lignite. Thickness and extent variable | Dakota aquifer<br>minor aquifer grading to confining unit. Low to moderate yields to wells |
| | | Nishnabotna Member | Massive sandstone, medium to coarse grained, with shale interbeds. Commonly over 200 feet thick. | major aquifer in much of northwest Iowa. |
| Paleozoic | Pennsylvanian | undifferentiated | mostly shale, with some sandstone, limestone and coal | confining unit not extensive in northwest Iowa. |
| | Mississippian | undifferentiated | limestone and dolostone | low to moderate yields to wells, significant aquifer only where near land surface. |
| | Devonian | undifferentiated | dolostone, shaly near top | |
| | Ordovician | Maquoketa | dolostone | |
| | | Galena | dolostone | |
| | | Decorah | shale | regional confining unit |
| | | Platteville | shale and shaly dolostone | |
| | | Glenwood | shale and oolitic ironstone | |
| | | St. Peter | sandstone, fine-grained and shaly. | Major regionally extensive aquifer |
| | | Prairie du Chien Group | dolostone and shale | |
| | Cambrian | Jordan | sandstone, medium-grained, dolomitic | |
| | | St. Lawrence | dolostone | No major aquifers |
| | | Davis | shale, some sandstone and dolostone | |
| | | Bonneterre | dolostone, silty | |
| | | Mt. Simon | sandstone | |
| Precambrian | | Sioux | quartzite and argillite, commonly weathered at top, low yields to wells | effective base of groundwater systems |
| | | undifferentiated | igneous and metamorphic rocks, very low water-bearing capacity. | |

## 2.4 HYDROGEOLOGY

Groundwater occurs in the glacial and alluvial sediments and in bedrock units below the Installation. A shallow alluvial aquifer exists within the Pleistocene glacial drift deposited in the Missouri River Valley. These glacial deposits consist of unconsolidated gravels, sands, silts and clays. These deposits are reported to be between 110 and 210 feet in thickness. The water table occurs within 20 to 30 feet of the ground surface in the vicinity of the Installation. Groundwater flow direction for this shallow aquifer is generally to the southwest and discharges to the Missouri River or nearby tributaries. The average hydraulic conductivity of the shallow aquifer at Site 1 ranged between $1.4\text{x}10^{-2}$ and $7.80\text{x}10^{-3}$ cm/sec. Locally, this shallow aquifer is very permeable and has reportedly yielded several thousand gallons per minute to wells. The Installation potable water is supplied by Sioux City municipal water which receives 90 percent of its water from wells located along the Missouri River. The alluvial aquifer is tapped by five of Sioux City's municipal wells north of the Installation as well as several private wells south of the Installation. These private wells are reported to be as shallow as 30 feet (HMTC, 1988). The City of Salix, Iowa, located eight miles southeast of the Base, also obtains its water supply from the alluvial aquifer. The City wells are located about six miles north of the Base.

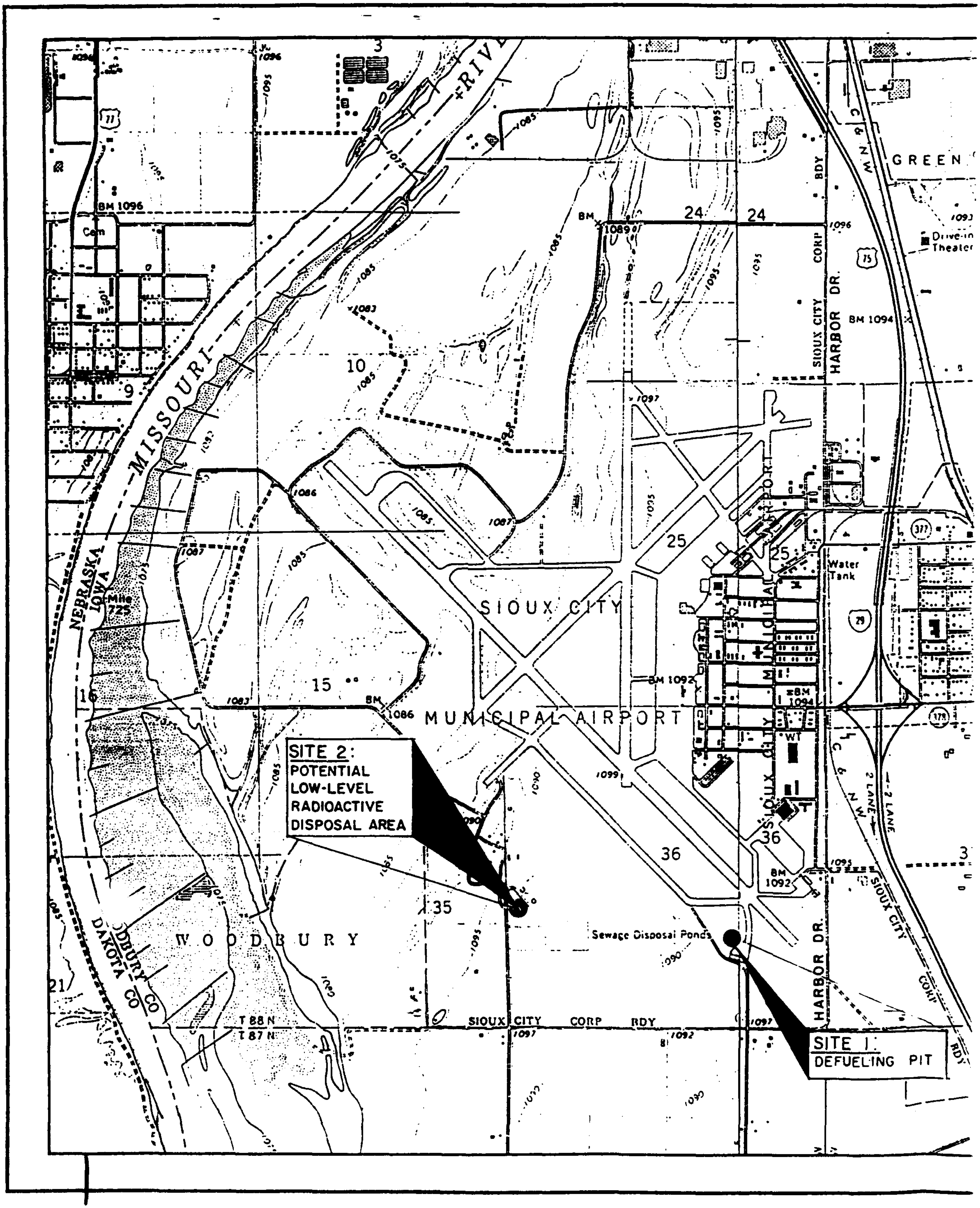
The Dakota aquifer is another important source of water in the region of the Installation. It occurs within the Nishnabotna Member of the Dakota Formation, a massive sandstone unit of Cretaceous-age rock. The Dakota aquifer is approximately 200 feet thick beneath the Installation and has a lateral extent which covers most of the northwestern portion of Iowa (Munter, et al., 1983). The aquifer is confined by overlying glacial tills and fine-textured Pleistocene sediment beneath the Installation. The groundwater within this aquifer flows toward the southwest and has a hydraulic gradient of five feet per mile. The average hydraulic conductivity of the Dakota aquifer is 40 to 45 feet per day (.014 to .016 cm/sec). Five municipal wells of Sioux City penetrate the Dakota aquifer to obtain the municipal water supply.

Another aquifer exists in Ordovician and Cambrian rock units. It consists of the St. Peter Formation, Prairie du Chien Group, and Jordan Formations and is confined by the overlying Ordovician shales. The Ordovician-Cambrian aquifer is regionally extensive over the western portion of Iowa.

## 2.5 TOPOGRAPHY AND DRAINAGE

The topography of the Installation is relatively flat with elevations varying from 1,085 to 1,095 feet above mean seal level (MSL) (Figure 2.6). This has resulted from the even distribution of sedimentary cover deposited by the Missouri River. The surrounding Missouri Alluvial Plain has a gently undulating topography with elevations ranging from 1,075 to 1,100 feet above MSL. The Alluvial Plain of the Missouri River is bordered in this area by 100 to 150 foot high bluffs which are composed of unconsolidated loess and glacial till.

The drainage of the Installation and surrounding area is dominantly controlled by the nearby Missouri River. The Missouri River and many of its natural tributaries have been channelized or straightened to accommodate roadways and control flooding in the area. According to the Iowa Department of Natural Resources, the Installation is not within the 100-year flood plain of the Missouri River. The surface runoff within the Installation is contained in channels and storm sewers which is directed into a drainage ditch that parallels Harbor Drive east of the Installation. This ditch had no outlet prior to 1984; therefore, the water either evaporated or percolated into the soil. However, in 1984 the ditch was reworked to allow the water to discharge directly into the Missouri River.


SITE 2:
POTENTIAL
LOW-LEVEL
RADIOACTIVE
DISPOSAL AREA
SITE 1:
DEFUELING PIT
SIOUX CITY
MUNICIPAL AIRPORT
MISSOURI
RIVER
NEBRASKA
IOWA
DAKOTA CO
WOODBURY CO
WOODBURY
Mile 725
Cem
GREEN
Drive-in Theater
Water Tank
WT
HARBOR DR.
SIOUX CITY CORP BDY
C & N W
2 LANE
Sewage Disposal Ponds
T 88 N
T 87 N
BM 1096
BM 1089
BM 1094
BM 1092
BM 1086
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75
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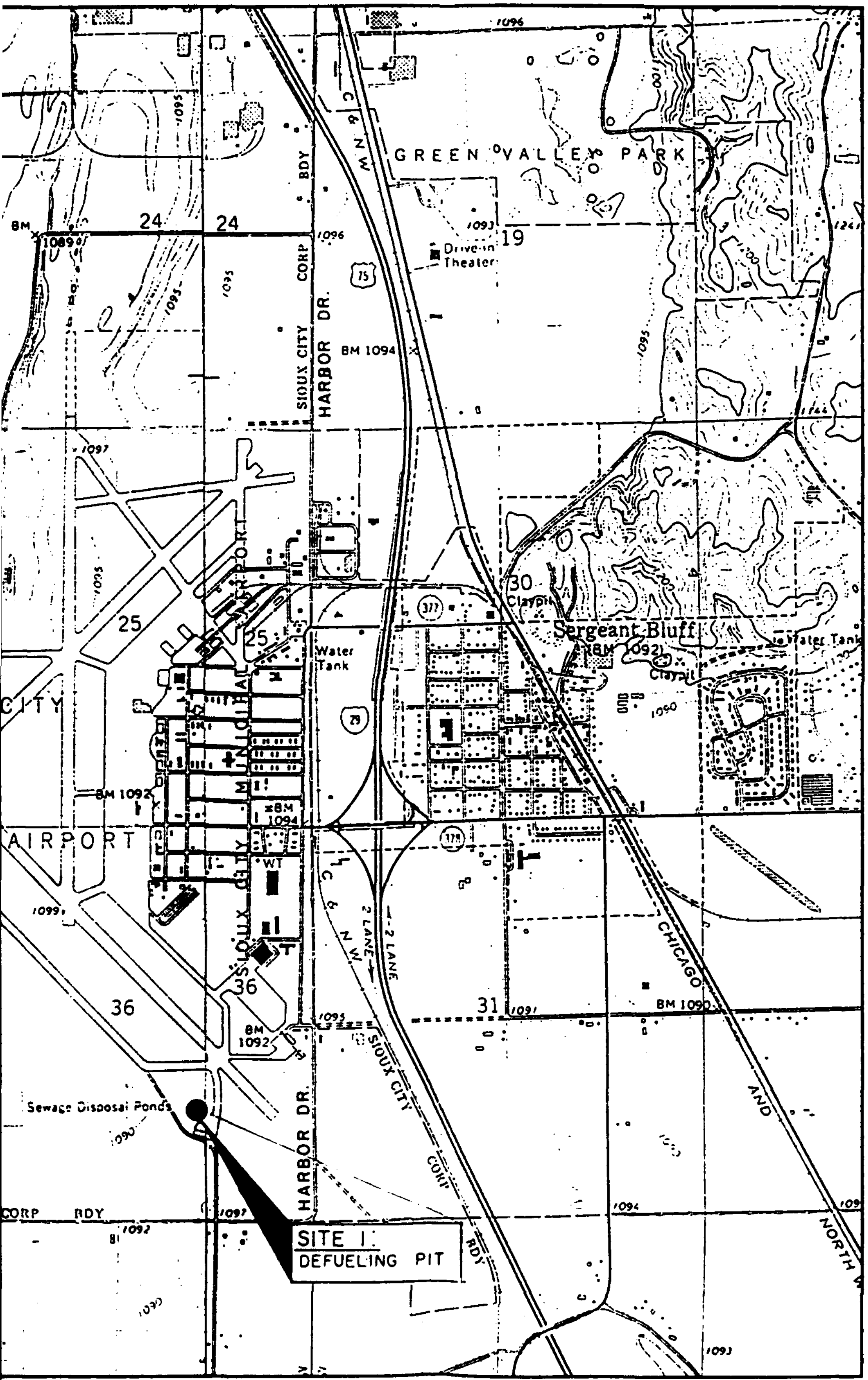
377
175



1000

**LEGEND :**

● SITE LOCATI

## TOPOG

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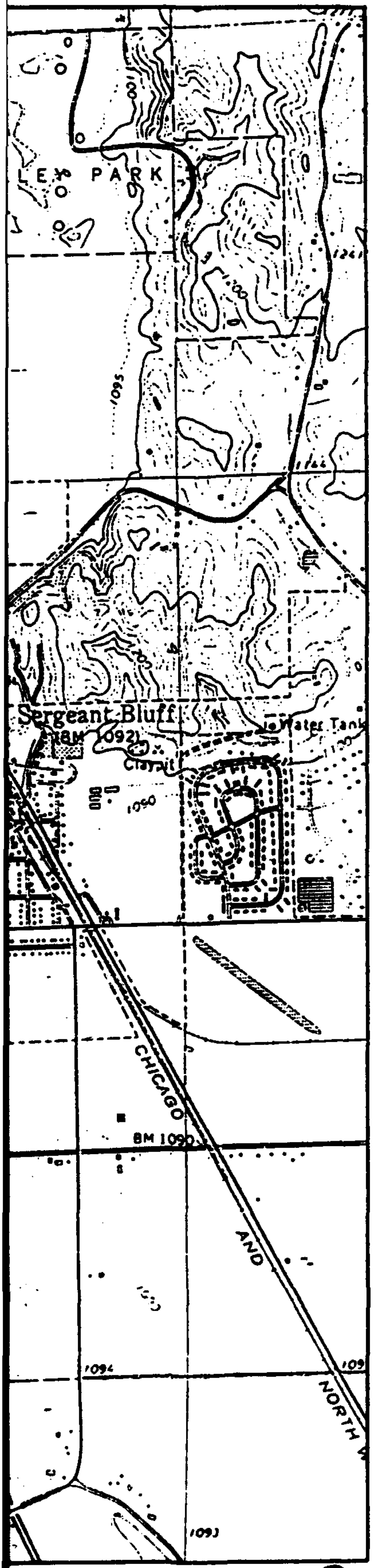
**SIOUX GA**

**SERGEAN**

2

FIGURE 2.6



1000 0 1000 2000 Feet

SCALE

**LEGEND :**

● SITE LOCATION

# TOPOGRAPHIC MAP

**IOWA AIR NATIONAL GUARD**
**185 th TACTICAL FIGHTER GROUP**
**SIOUX GATEWAY AIRPORT**
**SERGEANT BLUFF, IOWA**

3

# SECTION 3

# FIELD INVESTIGATION PROGRAM

## 3.1 PROGRAM DEVELOPMENT

The field investigation program described in this section was developed to determine whether or not the groundwater, surface water or soils of 2 sites at IANG contained specific chemical contamination. A Site Investigation (SI) Work Plan (ES, June 1990) was developed to define the objective of the SI. Included in the Work Plan is a detailed Sampling and Analysis Plan (SAP) to conduct a SI. The SAP includes descriptions of sampling methods and well construction specifications. Some of the techniques described in the following subsections deviate from the Work Plan. Where such a deviation occurs, it is based on the HAZWRAP Quality Control Requirements for Field Methods Document (HAZWRAP, 1989) or is a deviation prompted by field conditions. Appendices A through L contain supplemental field and analytical data.

## 3.2 FIELD INVESTIGATION PROCEDURES

This subsection describes the sampling methods and construction specifications used during the SI.

### 3.2.1 Decontamination

All split-spoon samplers, sampling trowels, bailers, pumps and other sampling equipment were decontaminated between samples by washing with soap and tap water, rinsing with tap water, rinsing with de-ionized, ultra-filtered water, and finally rinsing with methyl alcohol.

Augers and drill pipes were cleaned between borings by steam cleaning with tap water, washing with soap and tap water, and rinsing with tap water. The drill rig was steam cleaned between borings.

Decontamination wastes (water and soil) generated in the drill rig decontamination area were contained in a decontamination pad and placed in drums for later sampling

and disposal. The wastes from decontamination during drilling at the sites were placed into drums.

### 3.2.2 Surface Soil Sampling

The purpose of surface soil sampling was to determine the presence of contamination in the upper soil horizons. Surface soil sampling was utilized at Site 1 where JP-4 fuel was reportedly discharged.

One surface soil sample collected for volatile analysis was placed in a jar as quickly as possible to minimize loss of volatiles. The surface soil sample was collected using a stainless steel trowel.

### 3.2.3 Surface Water Sampling

One surface water sample was collected from the metal casing located in the center of Site 1. By immersing the sample bottles in the water and allowing it to fill, care was taken to stir up as little bottom sediment as possible while collecting the water sample. This casing measures about six feet in length.

### 3.2.4 Soil Borings

During the SI work, soil borings for the two inch ID monitoring wells were made using six-inch ID/9-3/4 inch OD continuous flight hollow-stem augers. Split-spoon soil samples were collected according to ASTM Method D-1586. Samples were collected continuously in all the soil borings. All borings were sampled to 30 feet deep.

Soil borings for piezometers (Site 1 only) were made using 3.25-inch ID/7.25-inch OD hollow-stem augers. Split-spoon samples were collected continuously. The three piezometers were sampled to 30 feet deep.

Upon collection, soils were classified with respect to type, by the visual-manual procedure (ASTM D-2488) noting mineralogy, color, odor, staining, etc. The samples were also field screened for the presence of volatile organic compounds (VOC). The test for VOC involved placing a portion of the sample, not intended for volatile analysis at the laboratory, in a glass jar, sealing the jar with foil, allowing the sample to equilibrate for at least five minutes, then inserting a photoionization detector (PID) probe through the foil to detect the presence of VOC in the headspace of the jar.

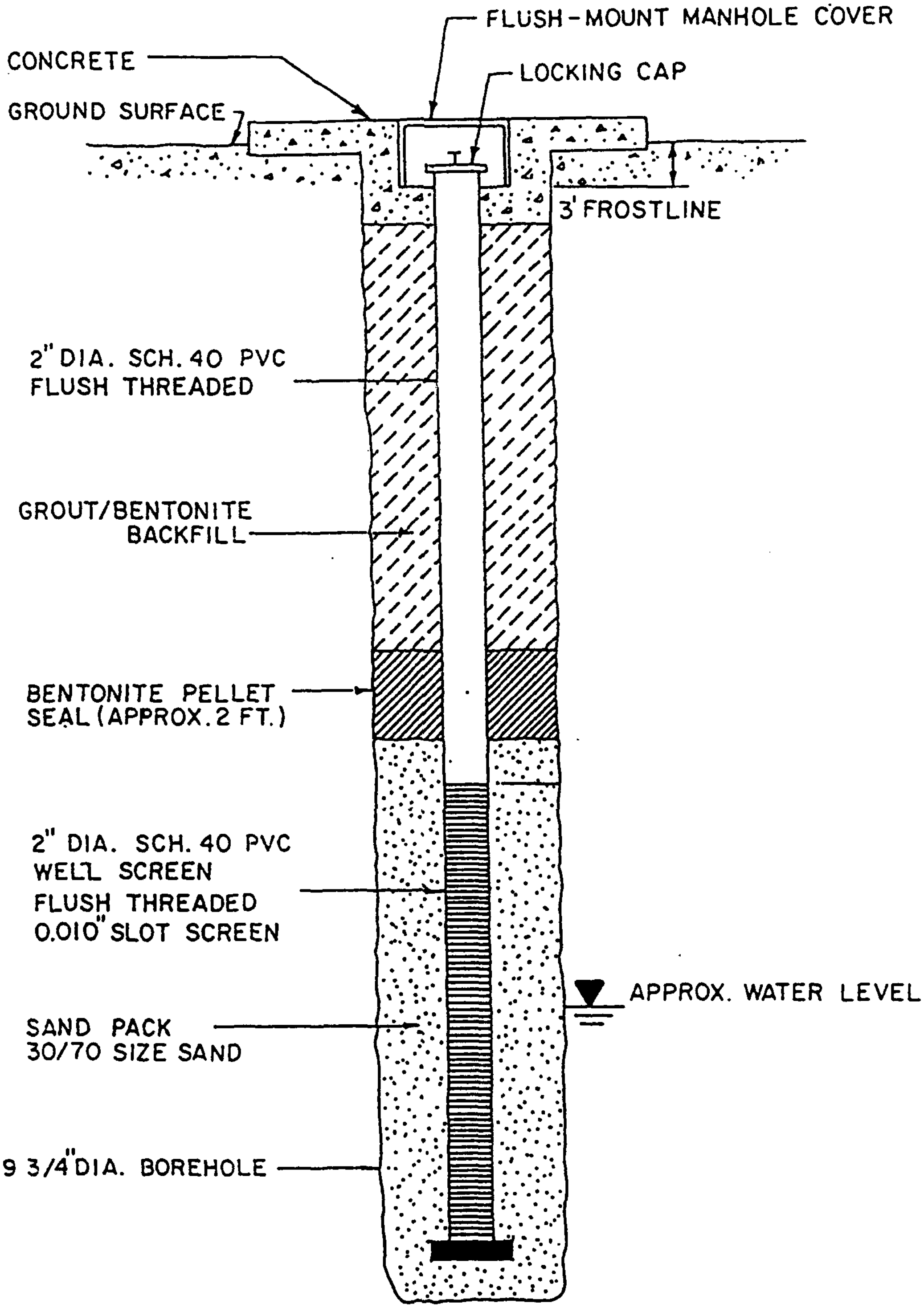
Generally, the two soil samples displaying the highest PID readings from each boring were submitted for chemical analysis. These samples selected for chemical analysis for semi-volatile and petroleum hydrocarbon constituents (CLP and U.S. EPA 418.1) were removed from the sampler and placed in 16 oz. glass jars with Teflon-lined lids for shipment to the laboratory. Samples for volatile analysis were placed in four oz. jars with Teflon-lined lids as quickly as possible to minimize volatilization. The sample bottle types that were used for soil samples are presented in Table 3.1.

### 3.2.5 Monitoring Well Construction, Completion and Development

The wells installed to monitor the shallow unconsolidated materials at the two sites consist of two-inch ID Schedule 40 PVC casing and screen. The casing and screen have threaded, flush joints and a threaded bottom cap. In all the wells, a ten-foot screen, machine slotted with 0.010 inch openings was set spanning the water table to detect floating contaminants and to allow for seasonal water table fluctuations. The screen and casing were installed through the augers. A quartz sand pack was placed around the screen while the augers were slowly withdrawn to prevent bridging of the sand. The sand pack extended two feet above the screen. The sand used was a 30/70 sand. The grain size distribution of this sand falls within the range 0.03 and 0.07 inches. A minimum two-foot thick bentonite pellet seal at Site 1 and 0.5 foot thick bentonite pellet seal at Site 2 was placed above the sand pack. The remaining annular space was filled with a cement/bentonite grout mixture at Site 1 and a bentonite slurry at Site 2. The piezometer installed at Site 1 were constructed in the same manner as monitor wells except that PVC used was one-inch ID. Typical monitoring well, piezometer and temporary well construction diagrams for the wells installed in the shallow aquifer are presented in Figures 3.1 and 3.2. Well locations at Sites 1 and 2 are found on Figures 3.3 and 3.4, respectively.

At Site 1, the wells were cut off three inches below grade and a locking protective lid consisting of a cast iron valve box assembly was installed in a concrete mixture above the cement grout. The top of the valve box was finished with a slight crest to facilitate runoff away from the well. The well number was imprinted on the top of the valve box lid. Each below-grade well was fitted with a water-tight cap.

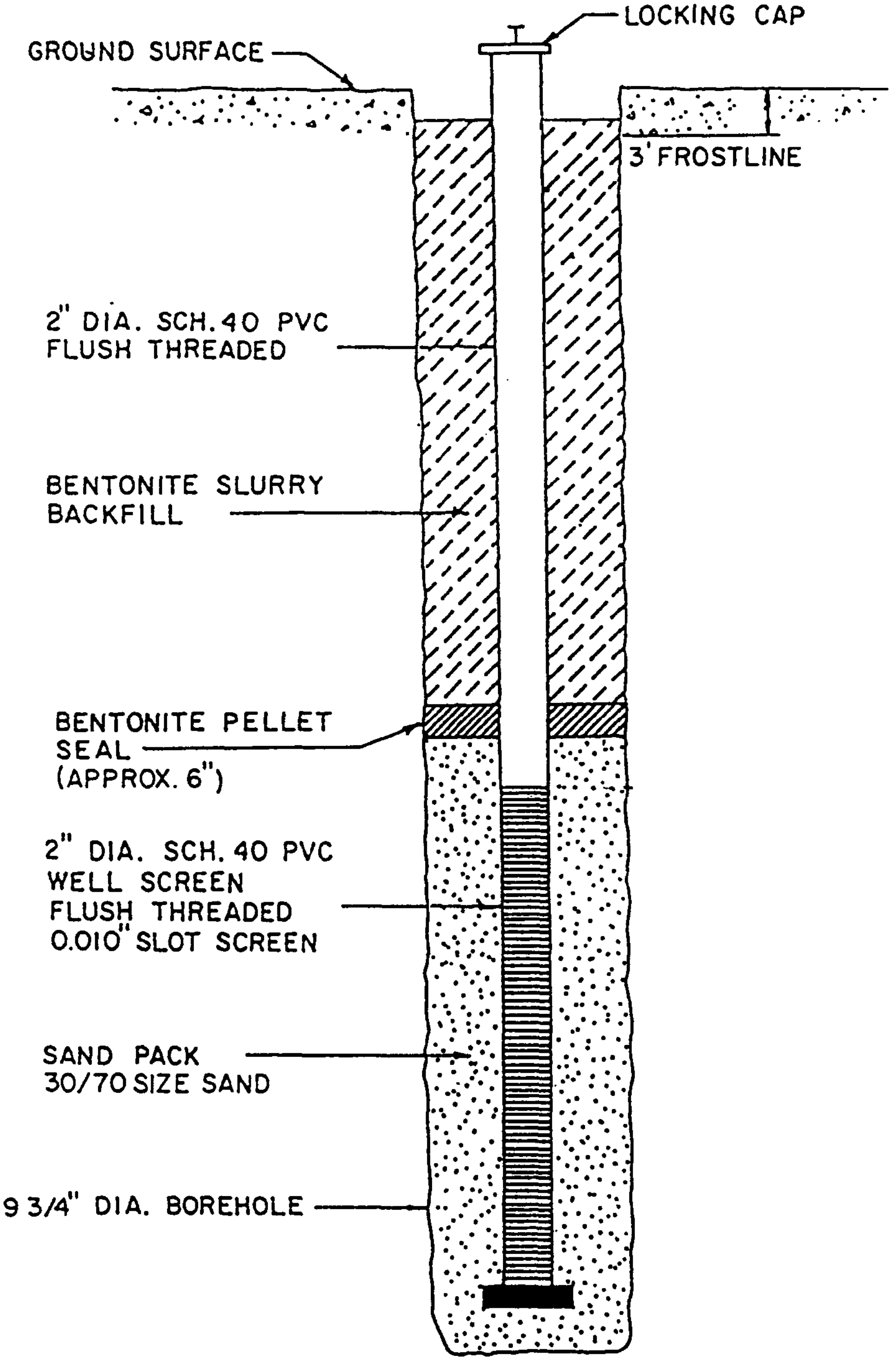
FIGURE 3.1



TYPICAL PERMANENT MONITORING WELL AND PIEZOMETER FOR FLUSH-MOUNT TYPE WELLS

SITE 1: DEFUELING PIT
IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

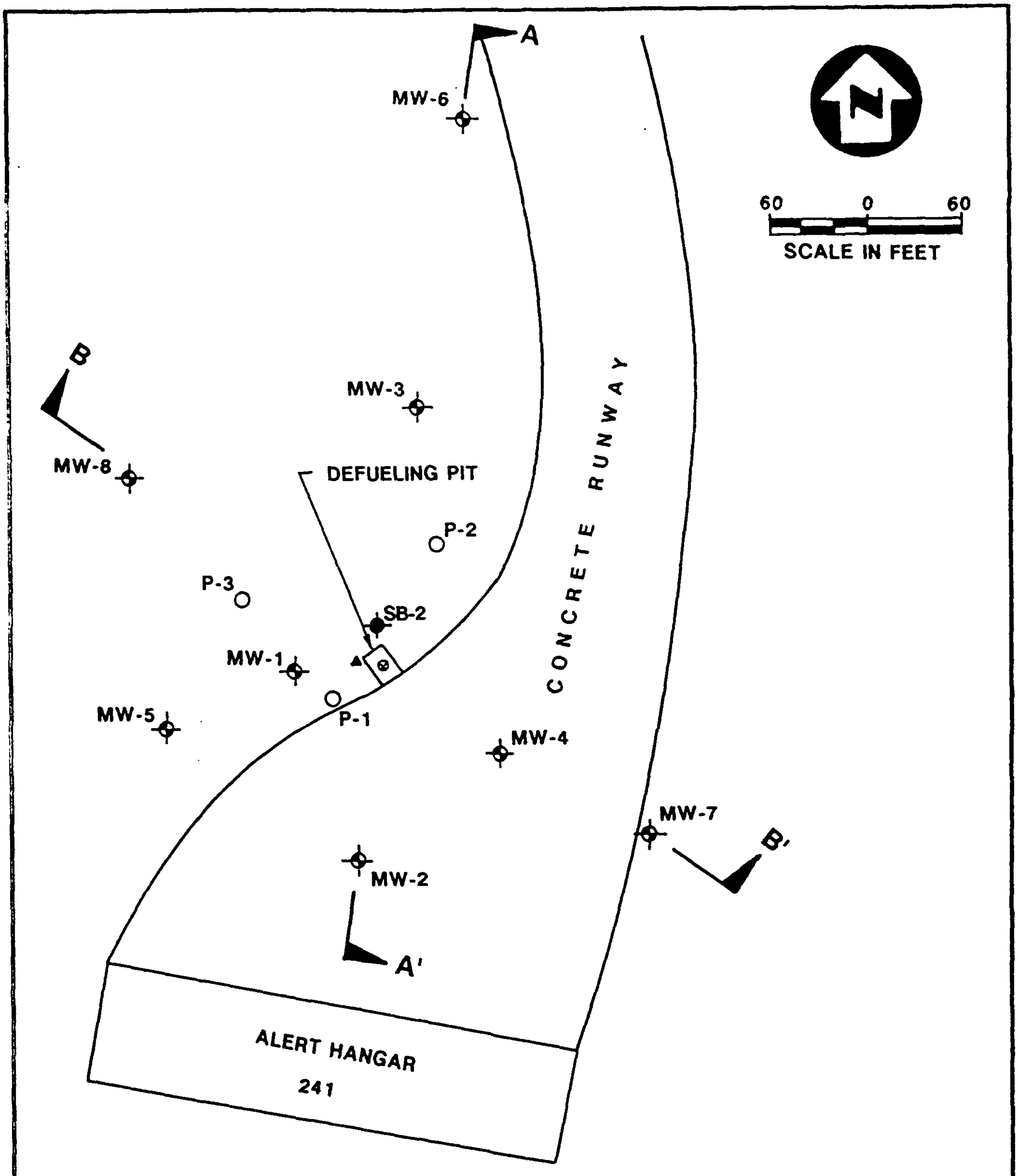
FIGURE 3.2



TYPICAL TEMPORARY WELL CONSTRUCTION

SITE 2: POTENTIAL LOW LEVEL
RADIOACTIVE WASTE DISPOSAL AREA
IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

FIGURE 3.3

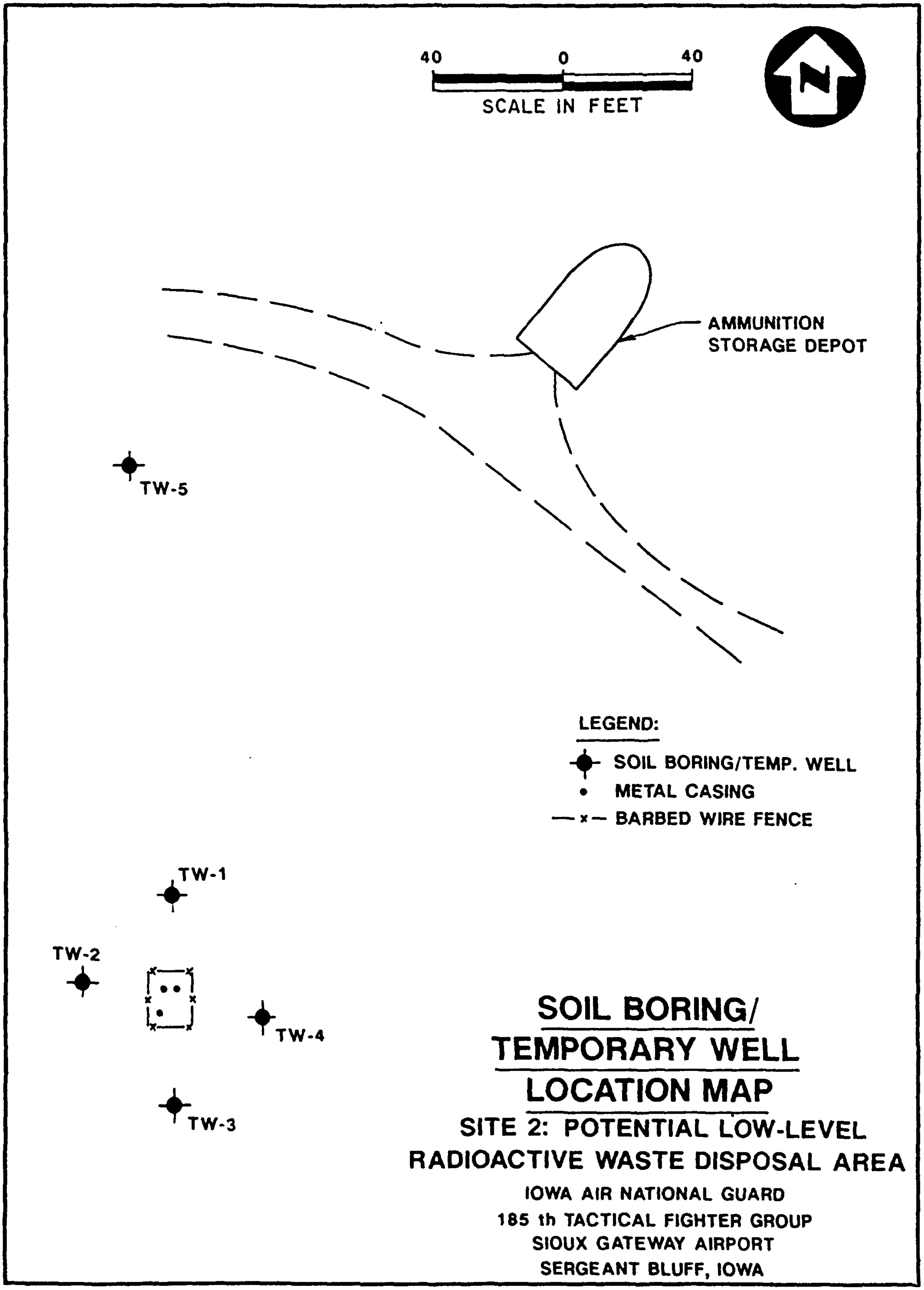


# BORING/MONITOR WELL OR PIEZOMETER LOCATION MAP

## SITE 1: DEFUELING PIT

IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

FIGURE 3.4



## SOIL BORING/ TEMPORARY WELL LOCATION MAP

SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

## TABLE 3.1

## ANALYTICAL METHODS AND COLLECTION SPECIFICATIONS FOR SOIL SAMPLES

## IANG - SERGEANT BLUFF, IOWA

| Analytical Parameter | Sample Prep Method | Sample Method | Preservation Container | Method | Holding Time |
|---|---|---|---|---|---|
| Aromatic Volatile Organics | 5030(1) | 8020(1) | 4 oz, widemouth glass w/Teflon liner | Cool, 4°C | 14 days |
| Semi-Volatile Organics | | CLP(2) | 16 oz, widemouth glass w/Teflon liner | Cool, 4°C | Samples must be extracted within 7 days and extracts analyzed within 40 days |
| Petroleum Hydrocarbons | 9071(1) | EPA 418.1(3) | 16 oz, widemouth glass w/Teflon liner | Cool, 4°C | 28 days |
| Gross Alpha & Gross Beta | | EPA 900.0(4) | 16 oz, widemouth glass w/Teflon liner | Cool, 4°C | 6 months |
| Radium 226 | | EPA 903.1 | 16 oz, widemouth glass w/Teflon liner | Cool, 4°C | 6 months |
| Radium 228 | | EPA 904.0 | 16 oz, widemouth glass w/Teflon liner | Cool, 4°C | 6 months |

1. Test Methods for Evaluating Solid Wastes, SW846, U.S. EPA, November 1986.
2. Contract Laboratory Program, Statement of Work for Organics (Number 2/88).
3. Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March 1983.
4. Prescribed Radiochemical Procedures for Drinking Water, EPA 600/4-80-032, 1980. (Soils initially prepared using D.O.E. Health and Safety Laboratory procedure.)

At Site 2, the wells were installed with approximately one foot of riser stick-up above grade. These wells were intended to be sampled one time, then be removed and the borehole grouted. The sampling and abandonment program at Site 2 has been completed.

Wells were developed by bailing. Wells were bailed until pH and conductivity had stabilized to ±ten percent. Approximately 45 gallons of water were removed from each well and contained in a 55 gallon drum.

### 3.2.6 Groundwater Sampling

Prior to sampling each monitoring well, the static water level was measured. The well was purged by bailing until the total well water volume (TWWV) had been removed and pH, conductivity and temperature had stabilized (± ten percent) or the well was dry (EPA, 1986). The pH, conductivity and temperature of the water were determined two times while purging the well. The TWWV includes water in the screen, riser and sand pack. The TWWV was calculated for a one foot two inch ID screen section in a ten-inch auger boring with 30 percent porosity sand pack. The resulting value of approximately two gallons of water per foot of saturated well was used to calculate the purge volume of each well. The volume of water removed from each well exceeded three casing volumes.

Water was purged and samples collected from the two-inch ID wells using a Teflon bailer with dedicated polypropylene line. The first sample withdrawn was put in a container for volatile analysis (Site 1). Other sample bottles were filled with the remaining water. Appropriate preservatives were added to the sample bottles at the laboratory before shipment to the site. Vials containing samples to be analyzed for volatile organics were checked to assure that no air bubbles were present before the samples were packaged for shipment. A summary of the types of sample bottles and preservatives used for water samples is presented in Table 3.2.

At Site 1, wells MW-1, -3, and -4 showed phase-separated free-floating hydrocarbons. Groundwater was not collected from these wells for analysis. A sample of the hydrocarbons was collected from MW-4 and submitted to the laboratory for a JP-4 fuel fingerprint analysis (Method modified 8015) along with a fresh sample of JP-4 fuel collected from a JP-4 fuel storage truck. This analysis is found in Appendix K.

## TABLE 3.2

## ANALYTICAL METHODS AND COLLECTION SPECIFICATIONS FOR WATER SAMPLES IANG - SERGEANT BLUFF, IOWA

| Analytical Parameter | Sample Method | Preservation Container | Method | Holding Time |
|---|---|---|---|---|
| Aromatic Volatile Organics | 8020(1) | 40 ml, glass Teflon - lined septum cap | HCl(4 drops), Cool, 4°C | 14 days |
| Semi-Volatile Organics | CLP(2) | 1 liter, amber glass w/Teflon liner | Cool, 4°C | Samples must be extracted within 7 days and extracts analyzed within 40 days |
| Petroleum | EPA | 1 Liter, amber glass | HCl to pH <2 | 28 days |
| Hydrocarbons | 418.1(3) | w/Teflon liner | Cool, 4°C | |
| Gross Alpha & Gross Beta | EPA 900.0(4) | 1 Liter plastic | $HNO_3$ to pH <2 | 6 months |
| Radium 226 | EPA 903.1 | 1 Liter plastic | $HNO_3$ to | 6 months pH <2 |
| Radium 228 | EPA 904.0 | 1 Liter plastic | $HNO_3$ to | 6 months pH <2 |

1. Test Methods for Evaluating Solid Wastes, SW846, U.S. EPA, November 1986.
2. Contract Laboratory Program, Statement of Work for Organics (Number 2/88).
3. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.
4. Prescribed Radiochemical Procedures for Drinking Water, EPA 600/4-80-032, 1980.

### 3.2.7 Sample Numbering System

Each sample submitted for laboratory analysis was assigned a unique sample identification number that describes where the sample was collected and what type of sample it is. Each sample number consists of a group of letters and numbers separated by hyphens. A summary of the system is presented in Table 3.3. For example, the first soil sample collected from soil boring 2 at Site 2 was labeled IANG-2-SB/MW-2-S1 and the water sample collected from monitoring well 2 at Site 1 was labeled IANG-1-MW-2. Numbering of duplicate, rinseate, field blank and trip blank samples incorporated some aspects of the basic numbering system. Duplicate soil samples were assigned numbers identifying the actual site number and sample location, but utilized fictitious sample numbers. For example, the duplicate for IANG-2-SB/MW-5-S3 was IANG-2-SB/MW-5-S4. Duplicate groundwater samples were assigned numbers which identified the actual site number but used a sample location number unique to that site. For example, the duplicate groundwater sample collected from IANG-1-MW-8 was IANG-1-MW-9, and a monitor well 9 does not exist at Site 1.

The true identity of the duplicate samples was not disclosed on sample labels or chain-of-custody forms, but was recorded in the field notebooks.

Rinseate samples were identified by the project identification site number and the sample number. For example, sample IANG-1-RB-4 was a rinseate sample collected after decontaminating the split-spoon sampler used to collect soil samples from IANG-1-SB-5/MW-4. Field blanks were identified by the same method as the rinseate samples, e.g., IANG-1-FB-1 (DIUF). The water source for the field blanks was identified as either (DIUF), de-ionized ultrafiltered water from a supplier, or tap water (TAP) from the city water supply. Trip blanks were identified by consecutive number and A or B for each of two 40 ml vials, e.g., 2A, 2B TRIP BLANK.

### 3.2.8 Sample Handling, Packaging and Shipping

All water and soil samples collected during the SI for chemical analysis were obtained with equipment that was decontaminated prior to each use. Appendix L contains documentation of the sampling jar decontamination. The samples were placed in pre-cleaned glass and plastic jars and bottles supplied by Environmental Sampling Supplies via Engineering-Science, Berkeley, CA., and Controls for Environmental

## TABLE 3.3

## SAMPLE NUMBERING SYSTEM

## IOWA ANGB - SERGEANT BLUFF, IOWA

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Project Identification:
IANG - Iowa Air National Guard

Site Identification:
The Site Number

Sample
SB - Soil Boring
MW - Monitoring Well
SV - Soil-Vapor Sampling Station

Sample Type:
S - Soil Sample
G - Groundwater Sample

Sample Number
Sample Number (consecutive for each sampling event)

Example Sample Number
IANG-2-SB-1-S1
Iowa Air National Guard
Site 2 - Soil Boring Number 1, Soil Sample Number 1

Pollution, Santa Fe, NM. Prior to sampling, each of the sample containers was labeled. Information on the labels included:

- Sample identification number;
- Preservatives added;
- Date and time of sample collection; and
- Required analytical method.

Sample containers were wrapped in packing material to minimize the chance of breakage during shipment and packed in plastic coolers. The coolers were then packed with sealed, ice-filled plastic bags. A chain-of-custody form was prepared for the contents of each cooler prior to packing. Information on each chain-of-custody form included sampling information recorded on the label of each sample bottle, and the total number of sample bottles for each sample. The form was then signed by the sampler(s), signed and dated by one of the samplers in the "relinquished by" box and the Federal Express airbill number was written in the "received by" box. The form was then placed in a sealed plastic bag and taped to the inside of the cooler lid. Each cooler was sealed with tape and a security seal and shipped by Federal Express to the ES Laboratories in Berkeley, California (Site 1) and Controls for Environmental Pollution Laboratories in Santa Fe, New Mexico (Site 2).

Upon receipt of a sample set, the laboratory inspected the shipping container for security seals before opening. The container was inspected for the chain-of-custody documents and other information or instructions. The sample custodian verified that the information on the sample bottles matched that on the chain-of-custody forms and signed for receipt. Any discrepancy between the samples received and the chain-of-custody information, broken or leaking sample bottles, or other abnormalities were reported to the laboratory supervisor. Notation of the problem and resolution was made on the chain-of-custody form, initialed and dated by the sample custodian.

Each sample was assigned a unique chronological laboratory number. A sample number label was attached to each bottle. All identifying information was recorded in a bound sample log book. The information documented included:

- Laboratory sample number;
- Date of receipt;
- Client name;
- Client identifying number or description;

- Project number;
- Analyses required, and
- Storage location.

Upon completion of the log-in procedure, the samples were stored in a secure area under the environmental conditions required to maintain sample integrity. A work order form was prepared and provided to the laboratory to assist in scheduling and completion of the tests within required holding times.

### 3.2.9 Field Measurements

Field measurements (pH, specific conductivity, and temperature) were collected for all water samples during the IANGB sampling activities. A brief discussion of the field measurement procedures is presented below.

**Temperature Measurement:** The temperature of each water sample was measured with a mercury thermometer.

**pH Measurement:** The pH of each water sample was measured with a portable pH meter. The meter was calibrated with buffer solutions of the appropriate range for the expected values of pH at the beginning of each day of sampling and the calibration data were entered into the field notebooks. The meter was also recalibrated periodically during periods of continued use.

**Conductivity Measurement:** The specific conductance of each water sample was measured with a portable field conductivity meter. A standard potassium chloride solution was used to calibrate the instrument prior to use each day. The meter was also recalibrated periodically during periods of continued use.

### 3.2.10 Analytical Methods and Procedures

The samples of soil, groundwater and surface water were analyzed for the parameters listed in Tables 3.1 and 3.2. The target compounds for methods using gas chromotography (GC) (8020), and gas chromatography/mass spectrometry (GC/MS), for semi-volatile organics under the Contract Laboratory Program (CLP) are listed in Table 3.4. Second column confirmation was performed for GC analyses when target compounds were present above detection limits. The detection limits for organic

## TABLE 3.4

## LIST OF COMPOUNDS FOR GC AND CLP METHODS
## IOWA ANGB - SERGEANT BLUFF, IOWA

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### SW 8020 - Aromatic Volatile Organics

Benzene
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethyl Benzene
Toluene
Xylenes (Dimethyl benzenes)

### Semi-Volatile Organics

Phenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl) ether
4-Methylphenol
N-Nitroso-di-n-dipropylamine
4-Chloro-3-methylphenol
bis(2-Chloroethoxy) methane
2,4-Dichlorophenol

1,2,4-Trichlorobenzene
Naphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol

2-Chloronaphthalene
2-Nitroaniline
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene

bis(2-Chloroethyl) ether
2-Chlorophenol
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
4-Chloroaniline
Hexachlorobutadiene
2-Methylnaphthalene

Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
4-Chlorophenyl-phenyl ether

Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine
Di-n-butylphthalate

Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

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compound analyses using GC or GC/MS methods are published in the respective methods (SW 846).

Laboratory internal quality control (QC) sampling included at least one blank, one matrix spike and one duplicate sample for each ten field samples received. One matrix/spike duplicate sample was analyzed for each set of samples received or every 20 samples, if sample sets had greater than 20 samples. Blind field duplicates were analyzed as quality assurance (QA) samples at a frequency of approximately one in ten. A summary of QC and QA results is presented in Appendix I.

### 3.2.11 Aquifer Testing

In-situ hydraulic conductivity tests utilizing the rising head slug test technique were conducted on ten monitoring wells showing no free hydrocarbons at IANG. Water level recovery data was collected with a HERMIT data logger (Model SE 1000B).

Prior to testing, static water levels were measured in each monitoring well with an electronic water level indicator. The transducer for the HERMIT data logger was inserted into each well to a depth of at least 5 feet below the static water level. In addition, a Teflon bailer (3 ft. in length and 1.6 in. outside diameter) was inserted and completely submerged in the well above the transducer. The water level in the well was allowed to return to the original static level.

Prior to initiation of the test, the static water level was remeasured with a water level indicator. The water level was entered into the data logger as a reference value from which changes in head over time during the test were measured. The data logger was then activated and the bailer rapidly removed from the well.

During the test, water level changes in each well were checked periodically with an electronic water level indicator as a means of validating the transducer data. When water levels in each well approached the initial static level (within 0.1 ft.) recovery was determined to be complete and the test terminated.

The raw data from each test was reduced and converted into hydraulic conductivity values according to the technique developed by Hvorslev (1951). Appendix F contains calculations and hydraulic conductivity values for each of the ten wells.

### 3.2.12 Soil-Vapor Survey

The soil-gas survey was used to obtain field measurements of BTEX parameters present in the soil. This screening method is useful for delineating areas of varying BTEX concentrations. Samples of vadose zone vapor were collected from 31 locations, based on a grid with 20 foot centers, from the area surrounding Site 1. These samples were obtained by driving to depth a hollow stainless steel probe into the ground. A vacuum pump was then attached by hose, to this probe and used to purge the location of extraneous vapors for 60 seconds prior to the collection of a representative soil-vapor sample.

To collect a soil-gas sample, a sample collection train was utilized. This train consisted of a vacuum desiccator with two valves, a TEDLAR sample collection bag, Teflon tubing and miscellaneous stainless steel hardware. To assemble this unit, the TEDLAR bag was attached to one of the valves entering directly into the interior of the desiccator. On the outside, this valve was attached directly to the soil-gas probe. A second valve was installed to allow for the creation of vacuum within the desiccator using the vacuum pump. To draw this gas into the TEDLAR sample bag, a vacuum was created in the desiccator, thereby drawing the vapors out of the ground and into the collection bag.

A gas-tight syringe was then used to extract an aliquot of the sample from the collection bag and inject it into a Photovac 10S70 portable gas chromatograph (GC) present onsite. This GC was equipped with a photoionization detector which utilizes a 10.6eV light source and an isothermal capillary column.

This GC was calibrated with daily prepared one ppm standards of benzene, toluene and xylenes. These standards were prepared by qualified ES personnel by injecting known volumes of pure benzene, toluene and xylene vapors into a one liter TEDLAR bag filled with ultra zero air. The amount of each vapor injected into this TEDLAR bag was such that a one ppm solution was created.

After gas samples were injected into the GC and analyzed, results were printed out as a chromatogram and a printout listing concentrations of standardized compounds present in the sample.

All sample collection and analysis equipment was decontaminated between each use. Decontamination was performed by forcing air through all equipment causing all contaminants to be volatilized.

A number of QA/QC procedures were followed during the course of the soil gas survey. Standard calibration checks were obtained during the initial and final runs of each day by injecting the standard gas mixture into the GC. Decontamination procedures were checked by injecting samples of ambient air that were passed through the sampling train and needles. If contamination was detected, decontamination was repeated until no contamination appeared. These types of blanks were done prior to each day's testing or when significant amounts of compounds were noted in a sample. A sample profile at two, four and six foot depths were taken at several sites in order to obtain an optimum sampling depth. Some samples were repeated in order to confirm recorder response and validity.

At Site 1, a sample spacing of 20 feet was used for 31 sampling points (Figure 3.5).

### 3.2.13 Radiological Survey

A *radiological survey* was conducted at the potential low-level radioactive waste disposal area (Site 2). The purpose of this survey was to determine surface radioactivity levels.

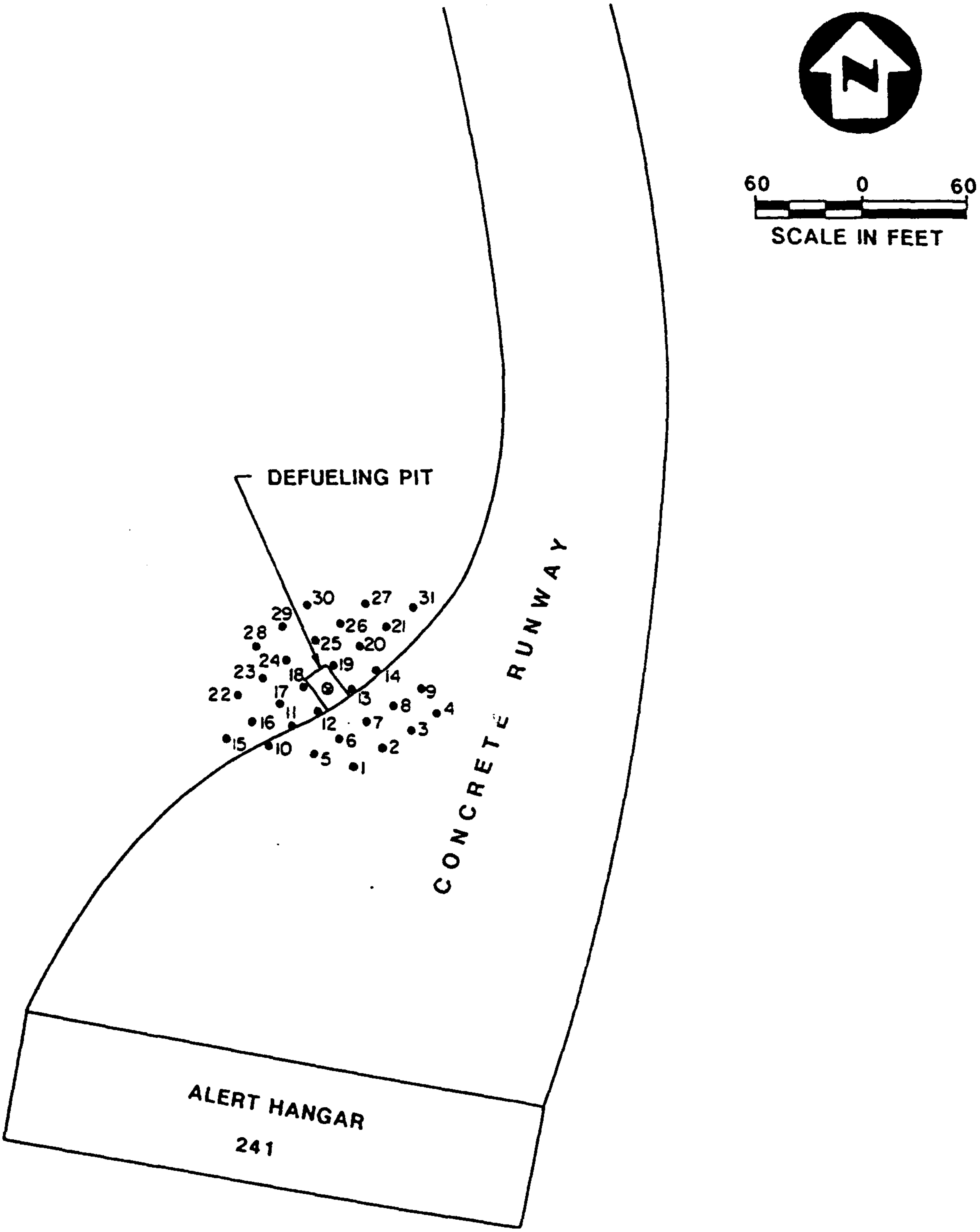
The survey was conducted using an Eberline Geiger Mueller survey meter, Model E-120. The instrument was calibrated at the factory and checked in the field with a vendor provided radioactive source prior to use.

The radiological survey consisted of recording the background radiation level approximately 200 feet from site and then obtaining general area readings three feet above the ground at 22 locations over the site (Figure 3.6). Six locations over and around the exposed portions of the storage containers were also checked with contact readings. Survey locations were recorded in the field log book.

### 3.2.14 Magnetometer Survey

At Site 2, a surface magnetometer survey was conducted. In this area, three metal containers are partially exposed. This survey was designed to identify the presence of

FIGURE 3.5



**LEGEND:**

● METAL CASING

• SOIL-GAS SAMPLING POINTS

# SOIL-GAS
# SAMPLING GRID MAP

## SITE 1: DEFUELING PIT

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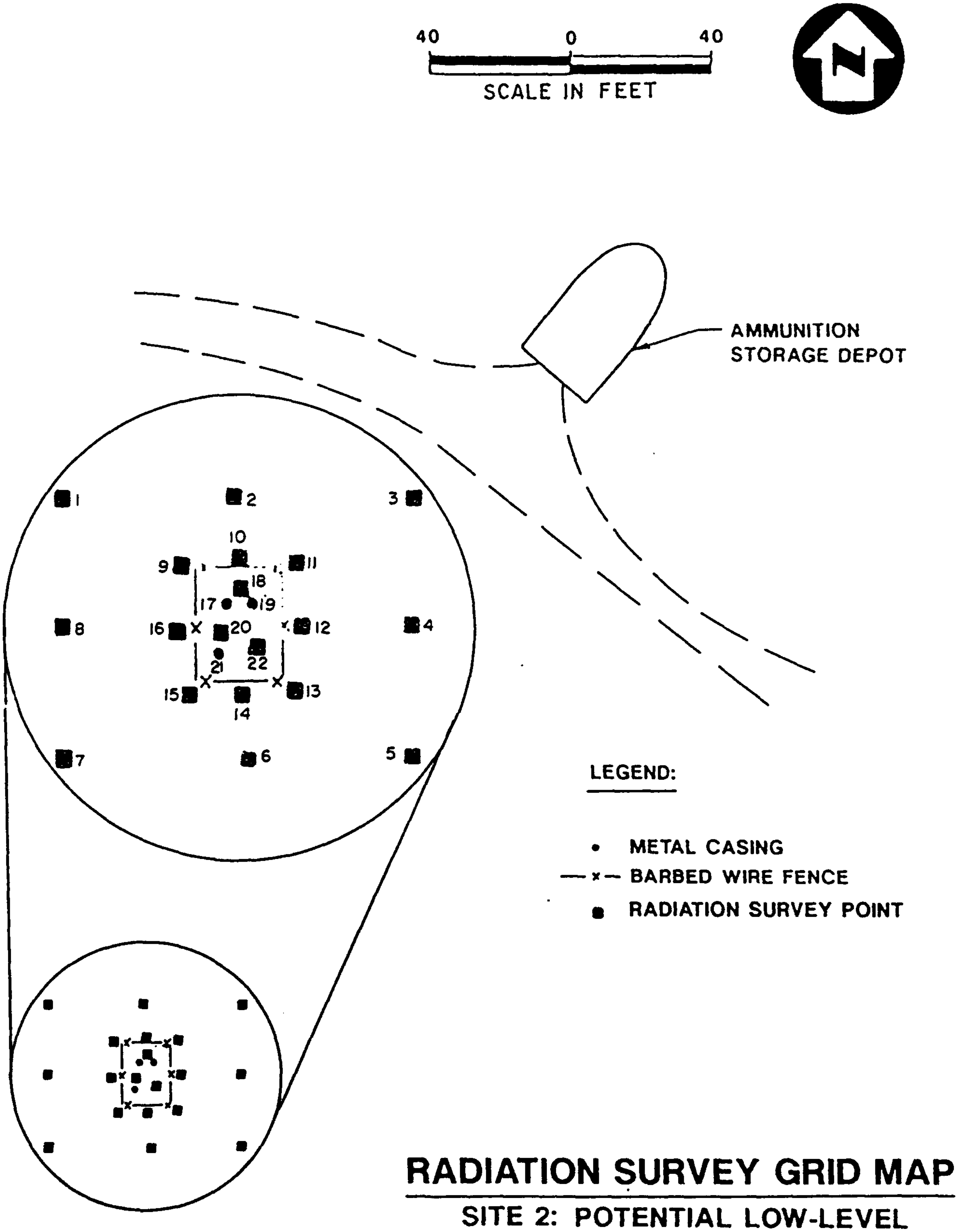
FIGURE 3.6



# RADIATION SURVEY GRID MAP

## SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

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other objects which may have been buried or to otherwise identify the approximate limits of the disposal area.

The magnetometer survey consisted of station-to-station measurements using a grid system. The stations were set five feet apart using a measuring wheel and a Brunton compass. The measurements were obtained using a Geometrics G826 Magnetometer which indicates the total magnetic field intensity at the site in gammas. The field measurements and grid locations were recorded in the field notebook.

### 3.2.15 Site Elevation Survey

The monitor wells at Site 1 and the temporary well grade elevations at Site 2 were surveyed by a licensed surveyor from Siouxland Engineering Associates, South Sioux City, Nebraska. The horizontal locations were determined to an accuracy of one foot. Elevations were determined with reference to U.S. Geological Survey benchmarks with an accuracy of ±0.01 foot.

At Site 2, the temporary wells were removed before the surveyor obtained top of casing elevations. Grade elevations were then taken at each temporary well location at Site 2.

## 3.3 DEVIATIONS FROM WORK PLAN

The following are descriptions of activities that deviated from the Work Plans.

At Site 1, the defueling pit, three of the eight wells installed had PSH. These three wells were not sampled, which is a plan deviation. The presence of PSH in the wells precluded the necessity of sampling to determine if contamination exists.

At Site 2, the potential low level radioactive waste disposal area, five temporary wells were installed as described in the Work Plans. The wells were sampled and results obtained prior to removal. It was the intent to have the wells surveyed by a local surveyor prior to the wells being removed. However, the surveyor did not complete the work and did not notify ES. The wells were removed and grouted back without having been surveyed. Once the problem was discovered, a survey of the grade elevations was discovered and a survey of the grade elevations of each temporary well was provided.

This information allowed preparation of generalized cross-sections, but no groundwater flow map could be prepared with confidence.

In general, soil sampling was conducted as outlined in the Work Plans. The use of a stainless steel split-spoon samplers was changed during installation of the first wells as the softness of the metal caused the sampler to become bent. At the point that this problem was discovered, a standard carbon steel split-spoon was employed.

In addition, two soil samples and a water sample were collected in the vicinity of a UST and analyzed for radiological parameters as background.

### Handling of Well Cuttings and Waters

All soils from borings having odors or elevated PID readings (>100 ppm) were drummed, labeled and stored on pallets at Site 1. Cuttings from wells or borings having no noticeable odors and less than 100 ppm on the PID were spread out on the site. Development waters of all wells sampled were drummed, labeled and placed on pallets at Site 1. The cuttings from Site 2 were drummed, labeled and brought to the storage area at Site 1, at the request of Installation personnel. Development waters from the temporary wells at Site 2 were also taken to Site 1.

Based on laboratory analyses of soil and water samples taken during the SI, soils from Site 1 should be disposed of in a landfill accepting soils containing petroleum hydrocarbons. From available information, soils collected at Site 2 do not contain levels of rad-components uncommon to the area and could be disposed of on site. Waters from Site 2 do not appear to exceed any ARARs. Water from wells 2 and 5 at Site 1 exceeded ARARs for benzene and should be disposed of as a hazardous waste, or with permission of the Iowa DNR, treated on site.

# SECTION 4

# RESULTS, CONCLUSIONS AND RECOMMENDED ACTIONS

This Section contains Subsection 4.1, a summary of contaminants found during the SI; Subsection 4.2, a description of the applicable or relevant and appropriate requirements (ARARs) which are used to evaluate the significance of the results at the individual sites; and Subsections 4.3 and 4.4, which each contain a site description, a description of field activities, and the results and conclusions for each site investigated. The site-specific subsections are organized into the following subheadings:

- Site Description
- Field Activities
- Results of Field Program
- Preliminary Risk Evaluation
- Significance of Results
- Conclusions and Recommendations

## 4.1 DATA EVALUATION

Data evaluation is the first step in assessing the results of the site investigation with respect to identifying contaminants and performing a preliminary risk assessment. Data evaluation includes the review of available analytical and physical data for the site, evaluation of analytical methods and data quality and development of the data base for use in subsequent risk characterization. Data validation was performed on all the analytical data collected during the Site Investigation. This was done in accordance with the Contract Laboratory Procedures (CLP) protocol and the HAZWRAP document Requirements for Quality Control of Analytical Data, DOE/HWP-65/RI. Results of the data validation are summarized in Section 5.

The valid data results are summarized in the following Section 4.1.1 and discussed in detail in the site-specific sections. A preliminary risk evaluation was performed for each site. The site-specific exposure assessment, Step 2 in the risk assessment process, is presented in each site-specific section.

The SI conducted at the IANG identified the presence of the following:

Site 1
- 4 Volatile organic contaminants in groundwater and surface water
- 4 Volatile organic contaminants in soils
- 1 semi-volatile organic contaminant in surface water
- 8 semi-volatile organic contaminants in soils
- TPH in surface water
- TPH in soils
- 3 radiological parameters in the groundwater and soil

Site 2
- 4 radiological parameters in the groundwater
- 4 radiological parameters in the soil

Table 4.1 summarizes the concentrations of compounds detected in groundwater and soil samples collected during the SI. The regulatory criteria which was used to evaluate the significance of the presence of these compounds are described in Subsection 4.2.

## 4.2 CRITERIA FOR EVALUATING RESULTS

The mere presence of contaminants in the environment due to past materials handling or waste disposal practices does not mean that the contaminants pose an unacceptable threat to human health or the environment. To ensure that resources for further investigations and remedial actions are efficiently committed, priorities must be established based on estimates of risk to human health and the environment. The objectives of this subsection are to present criteria for determining the significance of the results presented in later subsections in order that more accurate estimates of risk can be made. Applicable regulatory standards and guidelines were used as the criteria for determining the significance of the results.

Section 121 of the Superfund Amendments Reauthorization Act (SARA) addresses clean-up standards for superfund sites. This act sets forth the need for appropriate remedial actions, consistent with the National Contingency Plan (NCP), that provide a cost-effective response. The degree of cleanup specified in Subsection (d) of 121 of SARA is "to achieve applicable or relevant and appropriate requirements (ARARs) under other Federal or State laws." "Applicable" standards must be legally applicable to the hazardous substance or pollutant of concern. "Relevant and

## TABLE 4.1
## MAXIMUM CONCENTRATION OF CHEMICALS FOUND IN SOIL AND WATER
## SITES 1 & 2
## IANG, SERGEANT BLUFF, IOWA

| PARAMETER | SITE 1 SOIL | SITE 1 WATER | SITE 2 SOIL | SITE 2 WATER | SITE 1 SOIL SB-7 MW-6-BR1 | SITE 1 SOIL SB-7 MW-6-BR2 | SITE 1 WATER MW-6 |
|---|---|---|---|---|---|---|---|
| Volatile Organics (ug/kg or ug/l) | | | | | | | |
| Benzene | 5600 | 180 | NA | NA | | | |
| Ethylbenzene | 44000 J | 150 | NA | NA | | | |
| Toluene | 61000 J | 5 | NA | NA | | | |
| Xylenes | 100000 J | 360 | NA | NA | | | |
| Semivolatile Organics (ug/kg or ug/l) | | | | | | | |
| Naphthalene | 2700 | -- | NA | NA | | | |
| 2-Methlynaphthalene | 2900 | -- | NA | NA | | | |
| Dibenzofuran | 140 J | -- | NA | NA | | | |
| Fluoranthene | 440 J | -- | NA | NA | | | |
| Pyrene | 580 | -- | NA | NA | | | |
| Benzo(a)anthracene | 290 J | -- | NA | NA | | | |
| Chrysene | 340 J | -- | NA | NA | | | |
| Benzo(b)fluoranthene | 710 | -- | NA | NA | | | |
| 2,4-Dimethylphenol | -- | 10 J | NA | NA | | | |
| TPH (mg/kg or mg/l) | 3100 | 1 | NA | NA | | | |
| Radiological Parameters (pCi/g or pCi/l) | | | | | | | |
| Gross Alpha | 35.6+/-2.4 | 21+/-7 | 3.3+/-0.8 | 22+/-10 | 35.6+/-2. | 0.5U | 21+/-7 |
| Gross Beta | 7.8+/-1.3 | 32+/-7 | 5.3+/-1.0 | 45+/-12 | 7.8+/-1.3 | 0.8U | 32+/-7 |
| Radium-226 | 0.51+/-0.34 | 17.0+/-7.8 | 1.6+/-0.2 | 4.1+/-1 | 0.3U | 0.51+/-0.34 | |
| Radium-228 | -- | -- | 2.4+/-1.1 | -- | 0.5U | 0.5U | |

Footnotes:
-- Not detected
NA Not analyzed

appropriate" standards must be based on the circumstances presented by the release or threatened release. The U.S. EPA has identified three categories of ARARs:

- Chemical Specific;
- Location Specific, i.e., wetlands limitations or historic sites; and
- Action Specific, i.e., performance and design standards.

The evaluation of the significance of results for the SI considered only chemical specific ARARs.

## 4.3 SITE 1 - DEFUELING PIT

### 4.3.1 Site Description

The defueling pit is located north of the old alert hanger (Building No. 241). Excess JP-4 fuel in the F-100 aircraft was dumped into the pit approximately twice per month from 1961-1976. An estimated total of 180,000 gallons of JP-4 may have been released here. At the time of the SI, the dimensions of the pit were 42 by 18.5 feet and the pit was full of water. The surrounding area is flat with minimal relief.

Since there was no evidence to the contrary, it was assumed that only JP-4 was released to the pit and that the pit was unlined, allowing non-volatilized fuel to infiltrate the underlying soils. The capacity of the soil to accept the fuel was exceeded, causing some phase-separated fuel to reach the top of the zone of saturation and either remain there or laterally migrate. The soil vapor screening was intended to identify the approximate lateral migration of fuel components. The borings and wells were intended to provide data on the concentration left in the soils, whether phase-separated hydrocarbons were present atop the water table, and the degree of dissolved fuel components present in the underlying shallow groundwater. PSH are the relatively immiscible fraction present in fuels and oils. PSH tend to "float" on water in monitoring wells because the specific gravity of "floaters" is less than water.

The borings were used to identify the geologic conditions and the vertical extent of JP-4. Two-inch PVC wells were installed and screened across the water table to identify the presence of phase-separated hydrocarbons. Based upon the soil gas survey, borings/wells were drilled radially away from the pit to identify the horizontal extent of migration. Indicators of JP-4 were run on all laboratory soil and water samples analyzed. One background well was installed several hundred feet north of the defueling pit.

### 4.3.2 Field Activities

A 31 point soil-gas survey was conducted at Site 1 on 17, 18, and 19 July 1990. The results of the survey were used to assist in the location of soil borings and monitor wells surrounding the defueling pit.

Sampling began on 24 July 1990 with the collection of continuous soil samples to 30 feet for piezometer installations. These samples were screened in the field for VOCs with the photoionization detector (PID). The elevated PID readings were noted to determine the intervals with possible hydrocarbon contamination. The piezometers were installed to determine the groundwater flow direction on the site. Monitor wells were then located upgradient and downgradient of the defueling pit. Soil samples from piezometer borings were not submitted for chemical analysis.

Soil boring samples were collected from 31 July 1990 to 12 August 1990. These samples were collected in accordance with previously stated procedure (sub-section 3.2.4). All samples were tested for VOCs by headspace analysis with a PID. Two samples from each boring were selected for laboratory analysis based on elevated PID readings and/or stratigraphic interval. Table 4.2 shows the sample intervals selected for laboratory analyses. The samples were analyzed for volatile organics (Method 8020), semi-volatile organics (CLP) and total petroleum hydrocarbons (Method 418.1).

Monitoring wells were installed in the soil borings at Site 1. Immediately after the last soil sample was taken, the well was installed through the hollow-stem augers then the augers were removed as the sand pack and bentonite/cement grout were installed. One soil boring was not converted to a monitoring well. It was abandoned during the delineation of the PSH plume.

Monitor wells IANG-1-MW-1, IANG-1-MW-3 and IANG-1-MW-4 were installed nearest the defueling pit and showed PSH in the wells after installation. The soil-gas survey indicated these locations to be generally high in total BTEX concentrations.

Monitor wells IANG-1-MW-2, -5, -6, -7 and -8 were installed radially from the defueling pit in order to delineate the edge of the PSH plume. These wells showed no PSH after installation. These wells were developed on 14 August 1990. Development was conducted using a 1.5-inch I.D. by 3 foot long Teflon bailer. 45 gallons were bailed from each well and contained in a 55 gallon drum.

## TABLE 4.2

## SOIL HEADSPACE ORGANIC VAPOR ANALYSIS(1)
## SITE 1 - DEFUELING PIT

## IANG - SERGEANT BLUFF, IOWA

| Sample(2) Location | Sample No. | Sample(3) Depth (feet) | PID(4) (ppm) |
|---|---|---|---|
| MW-1 | S1 | 20 - 22 | 4920 |
| | S2 | 22 - 24 | 4790 |
| MW-2 | S1 | 22 - 24 | 3637 |
| | S2 | 24 - 26 | 2811 |
| MW-3 | S1 | 18 - 20 | 6209 |
| | S2 | 20 - 22 | 6748 |
| MW-4 | S1 | 20 - 22 | 4500 |
| | S2 | 24 - 26 | 5000 |
| MW-5 | S1 | 4 - 6 | 119 |
| | S2 | 26 - 28 | 2.9 |
| MW-6 | S1 | 8 - 10 | 139 |
| | S2 | 20 - 22 | 77 |
| MW-7 | S1 | 8 - 10 | 65 |
| | S2 | 22 - 24 | 2.8 |
| MW-8 | S1 | 16 - 18 | 19 |
| | S2 | 20 - 22 | 23 |

---

(1) Measured with a photoionization detector (PID) in parts per million.
(2) Boring/well locations are shown on Figure 2.2. Boring logs are included in Appendix B.
(3) Approximate sample depth.
(4) Samples submitted for laboratory analysis based on highest PID readings.

Groundwater samples were collected on 15 August 1990 and submitted for laboratory analyses. A duplicate from well IANG-1-MW-8 was also submitted for laboratory analyses. The wells were purged using a 1.5-inch by 3-foot Teflon bailer. Purging was conducted as described in sub-section 3.2.6. The purge water was added to the development water contained in a 55 gallon drum. These samples were analyzed for volatiles (Method 8020), semi-volatiles (CLP), and TPH (Method 418.1). In-situ hydraulic conductivity tests were run on the wells on 22 August 1990.

### 4.3.3 Results of Field Program

#### 4.3.3.1 Soil-Gas Survey Results

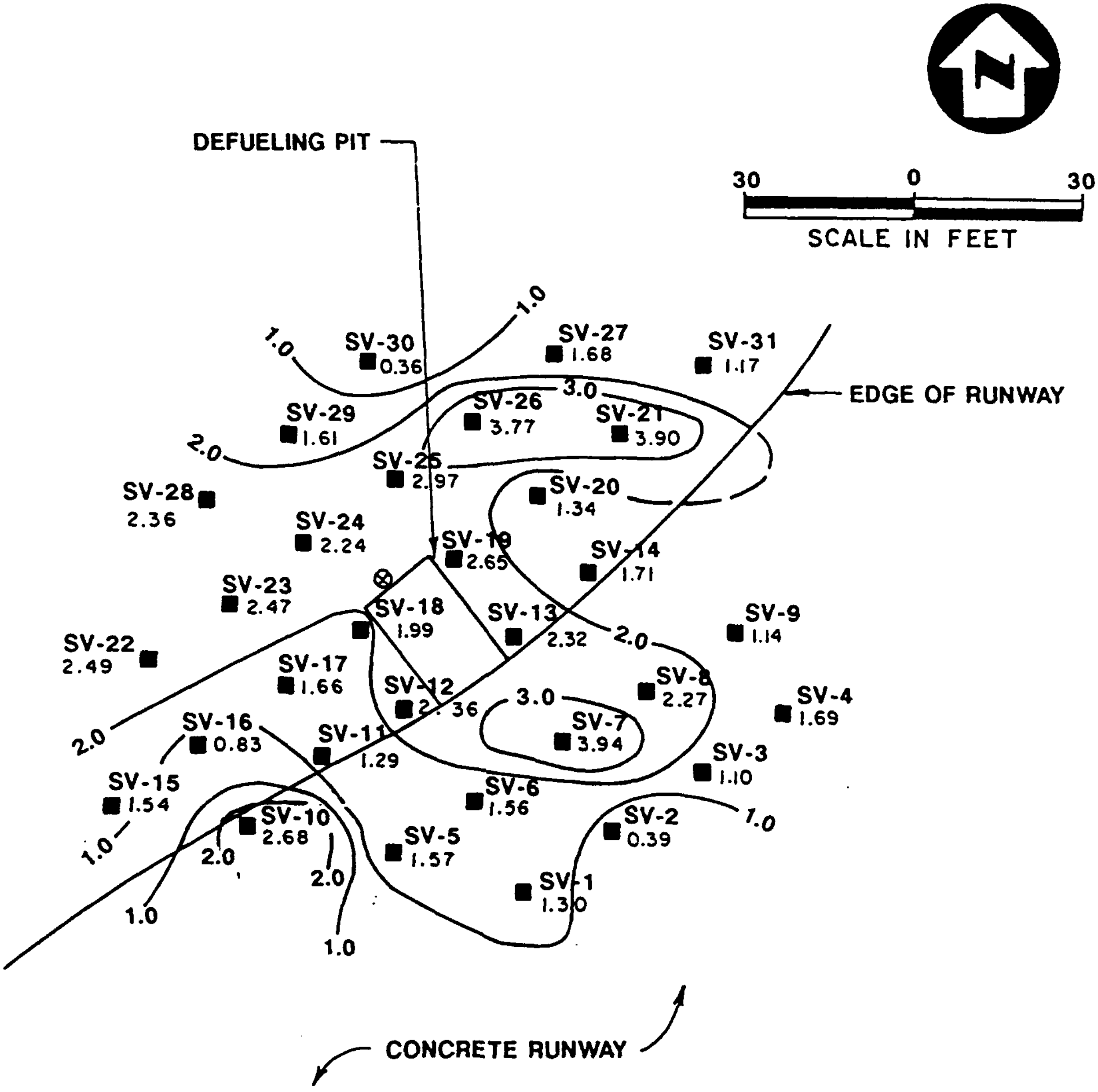
The soil gas survey identified two areas of elevated total BTEX concentration. The sample from IANG-1-SV-7 (Figure 4.1) contained the highest concentration (3.943 ppm). Samples IANG-1-SV-21 and -26 contained the next highest BTEX concentrations of 3.900 ppm and 3.767 ppm, respectively. This data is summarized in Appendix D. The other points indicate a limited extent of volatile organic contamination at the perimeter of the survey zone.

#### 4.3.3.2 Hydrogeologic Results

The borings for monitor wells IANG-1-MW-1, -MW-2, -MW-3 and -MW-4 penetrated brown and gray silt and silty clay overlying brown and gray silty sand. Elevated headspace PID responses of up to 6,700 ppm were obtained from soil samples below 14 feet and hydrocarbon odors were detected over the same interval. The wells were installed to 30 feet (see Logs, Appendix E). The ten foot well screen spanned the unsaturated and saturated zone interface in a fine-grained silty sand. Water was detected during drilling at 24 to 25 feet. The usefulness of a PID for on-site screening is that relative differences between concentrations of volatile organic contaminants present in samples can be established in the field. Based on this screening information, samples can be selected for laboratory analysis.

The borings for IANG-1-MW-5, -MW-6, -MW-7 and -MW-8 penetrated the same soil section sequence as the other wells but did not have elevated headspace PID responses or odors. The wells were installed to 30 feet. The 10 foot well screen spanned the unsaturated and saturated zone interface in a fine-grained silty sand. Water was detected at 23 to 25 feet.

FIGURE 4.1



**LEGEND:**

⊗ METAL CASING

■ SOIL-GAS SAMPLING POINTS

■ SV-1 SOIL-GAS SAMPLE NUMBER
1.30 TOTAL BTEX CONCENTRATION (ppm)

—1.0— TOTAL BTX ISOCON (PPM)

## SOIL-GAS TOTAL BTEX ISOCONCENTRATION MAP

### SITE 1: DEFUELING PIT

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Water levels were measured in all the wells on 13 August 1990. The water levels ranged from 22.70 to 25.08 feet below grade. The groundwater gradient is somewhat flat and variable in the Site 1 vicinity with dominant flow direction to the south-southwest toward the Missouri River (Figure 4.2).

In-situ hydraulic conductivity testing in IANG-1-MW-2,-5,-6,-7 and -8 revealed values ranging from $7.80 \times 10^{-3}$ to $1.41 \times 10^{-2}$ cm/sec (see Appendix F). Estimated groundwater flow velocities range from $4.20 \times 10^{-2}$ ft/day to $7.59 \times 10^{-2}$ ft/day assuming an effective porosity of 0.2 with the local flow gradient measured across the site as $3.8 \times 10^{-4}$. Phase-separated hydrocarbons (PSH) were measured in IANG-1-MW-1,-3 and -4 at thicknesses over two feet on 13 August 1990 (Figure 4.3). Table 4.3 provides water elevations and phase-separated hydrocarbon thickness for the Site 1 monitor wells. The nominal diameter of the piezometers were too small to permit insertion of a probe and consequently water levels and PSH were not measured. Regulatory personnel from the State of Iowa DNR were notified of the PSH by a representative from IANG.

#### 4.3.3.3 Chemical Analysis Results

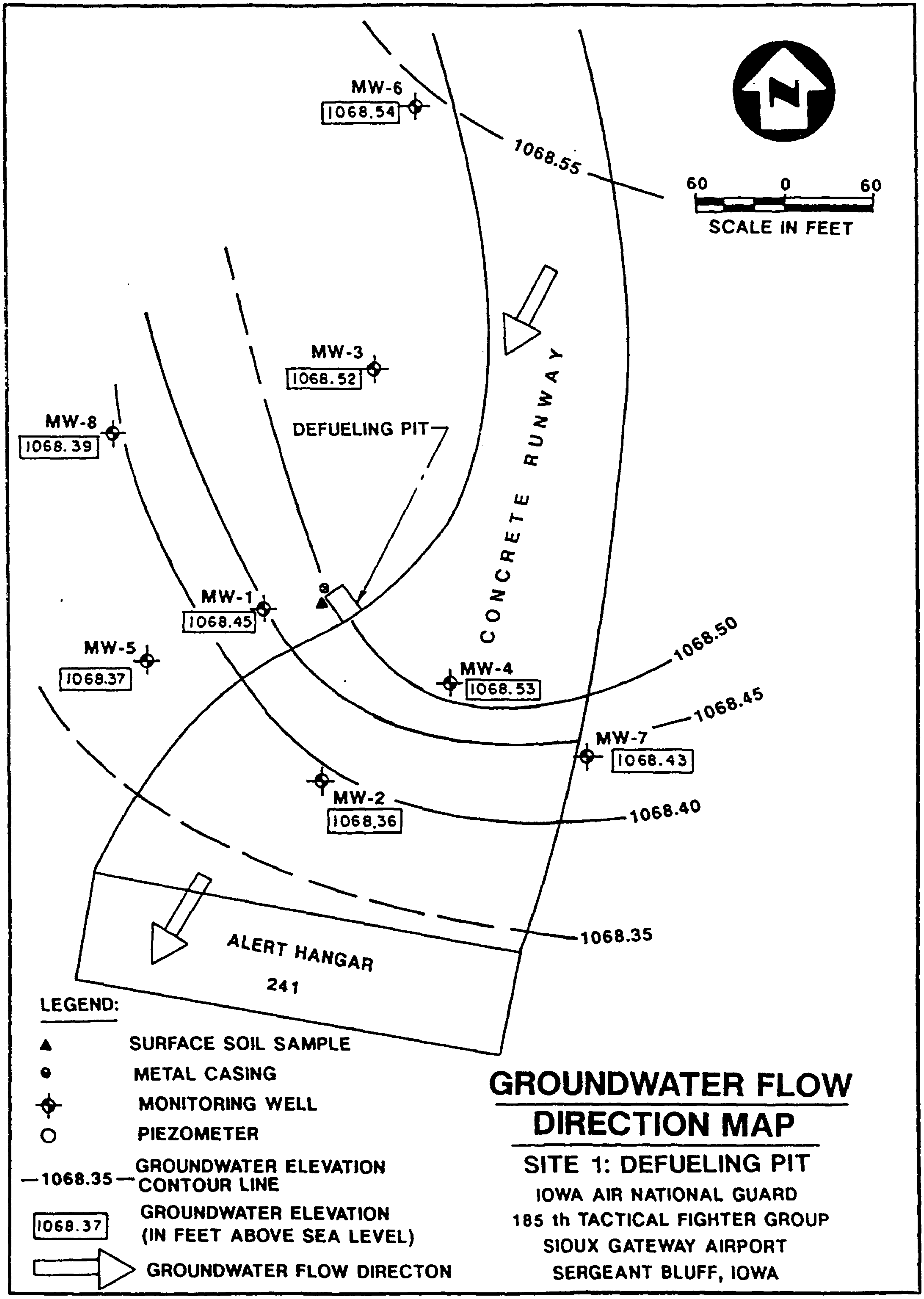
Soil samples were collected at Site 1 during the drilling of monitor wells and the collection of one surface soil sample (Table 4.4). All the soil samples submitted to the laboratory were analyzed for volatile organic compounds (8020), semi-volatile compounds (CLP) and total petroleum hydrocarbons (418.1). The analytical results are summarized in Table 4.5. Soil samples from MW-6 were also analyzed for Gross Alpha, Gross Beta, Radium 226 and Radium 228 and these results are summarized in Table 4-17.

The soil samples collected during the drilling of IANG-1-SB-1, MW-3, and MW-4 contained detectable concentrations of benzene, toluene, ethylbenzene and xylenes and total petroleum hydrocarbons (TPH). The semi-volatiles naphthalene and 2-methylnaphthalene were also detected in these soil samples.

Soil samples collected during the drilling of IANG-1-MW-2, MW-5, MW-6, MW-7 and MW-8 contained detectable concentrations of volatile organics and TPH. The semi-volatiles were not detected.

The surface soil sample collected from the defueling pit area revealed detectable concentrations of volatile organics (xylenes), semi-volatiles (pyrene, benzo(b)-fluoranthene) and a TPH concentration of 160 mg/kg (Figure 4.5).

FIGURE 4.2



## GROUNDWATER FLOW DIRECTION MAP

### SITE 1: DEFUELING PIT

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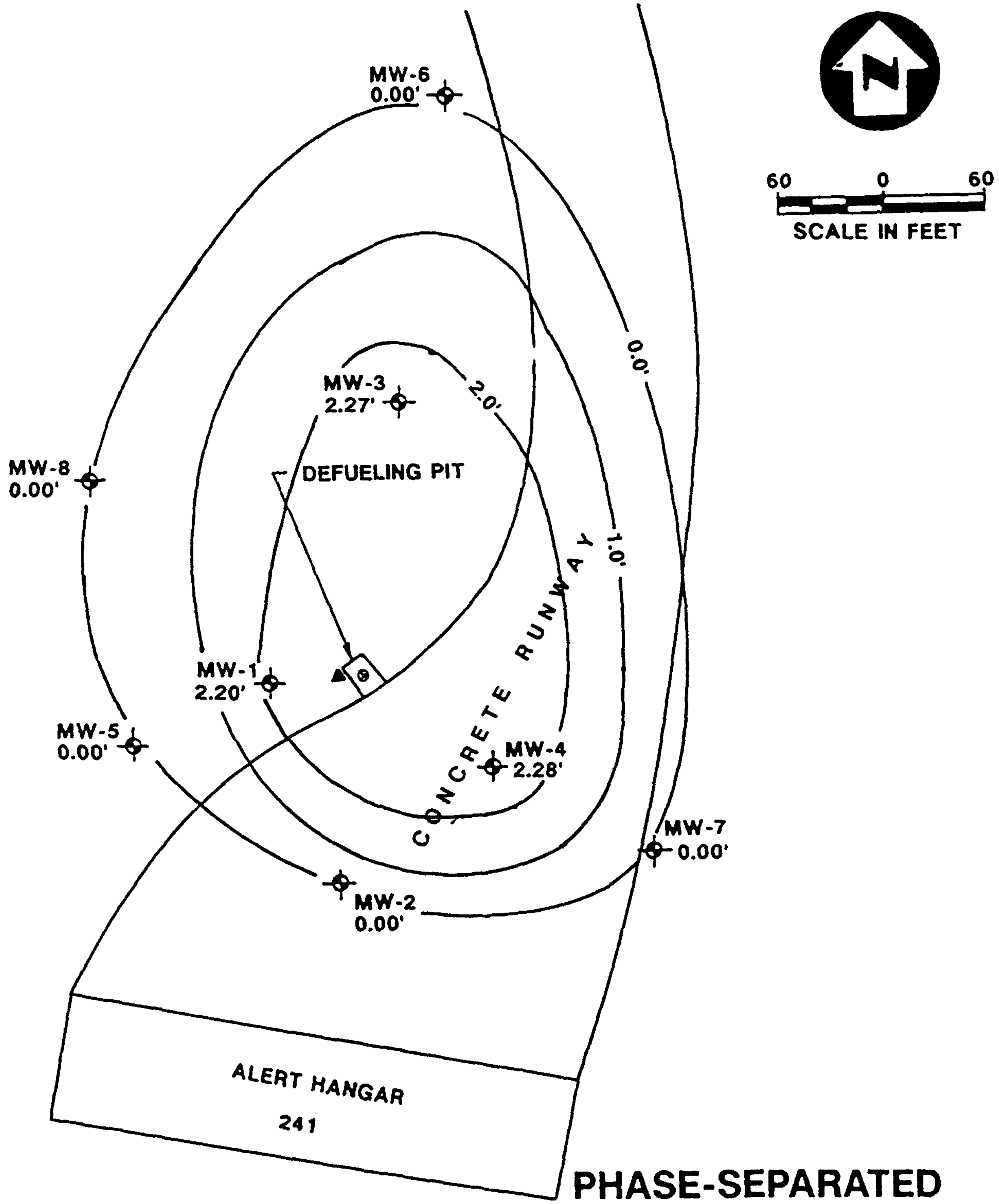
SERGEANT BLUFF, IOWA

FIGURE 4.3



LEGEND:

▲ SURFACE SOIL SAMPLE

⊗ METAL CASING

⊕ MONITORING WELL

○ PIEZOMETER

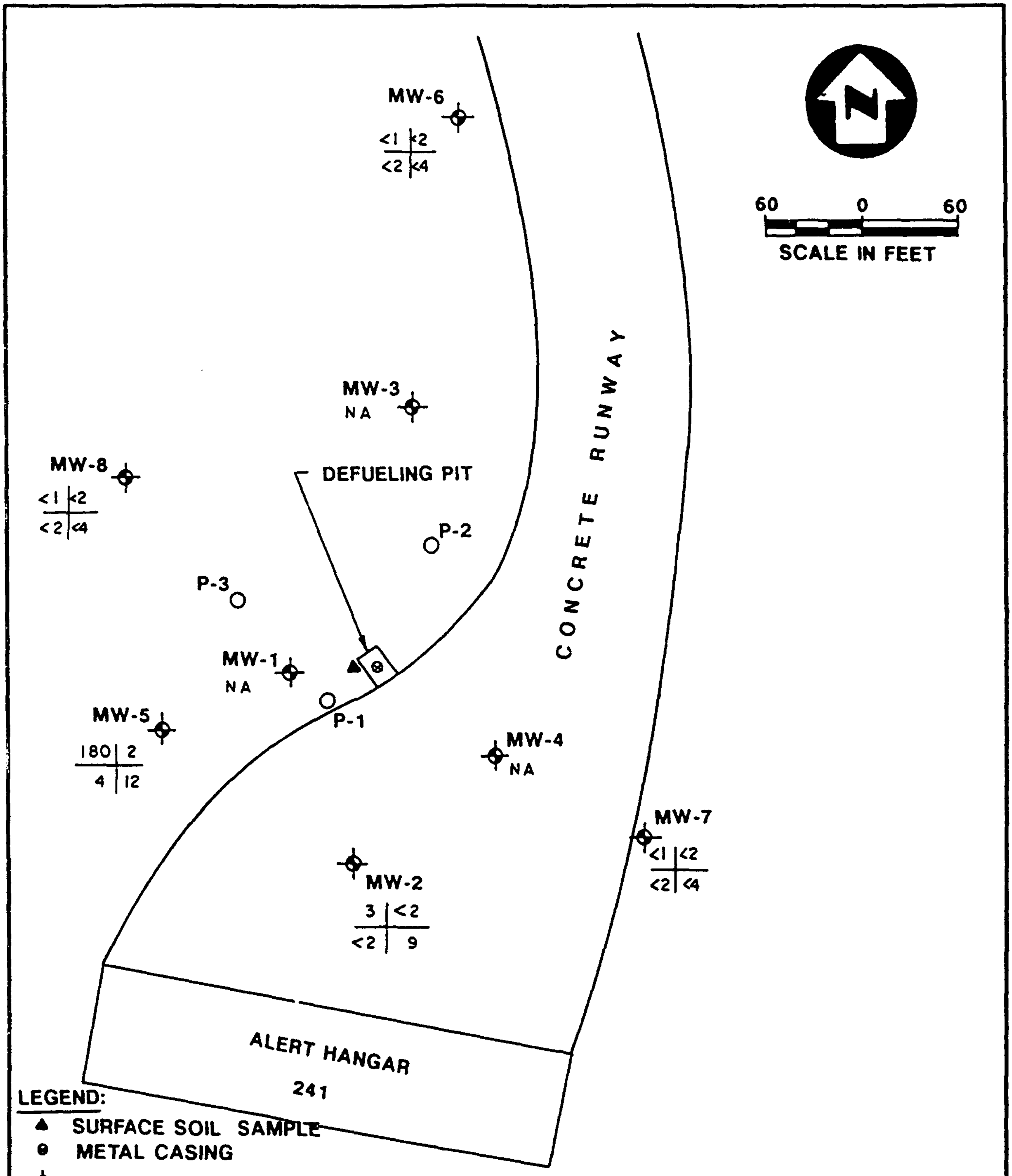
—1.0'— PHASE-SEPARATED FREE-FLOATING HYDROCARBON THICKNESS CONTOUR LINE (IN FEET)

# PHASE-SEPARATED FREE-FLOATING HYDROCARBON THICKNESS MAP

## SITE 1: DEFUELING PIT

IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

FIGURE 4.4



LEGEND:

- ▲ SURFACE SOIL SAMPLE
- ⊗ METAL CASING
- ⊕ MONITORING WELL
- ○ PIEZOMETER

| 1 | 2 | BENZENE | TOLUENE |
|---|---|---|---|
| 2 | 4 | ETHYLBENZENE | XYLENES |

NA NOT APPLICABLE-GROUNDWATER NOT SAMPLED DUE TO PHASED-SEPARATED FREE-FLOATING HYDROCARBONS IN WELL

## GROUNDWATER BTEX CONCENTRATION MAP (ppb)

### SITE 1: DEFUELING PIT

IOWA AIR NATIONAL GUARD
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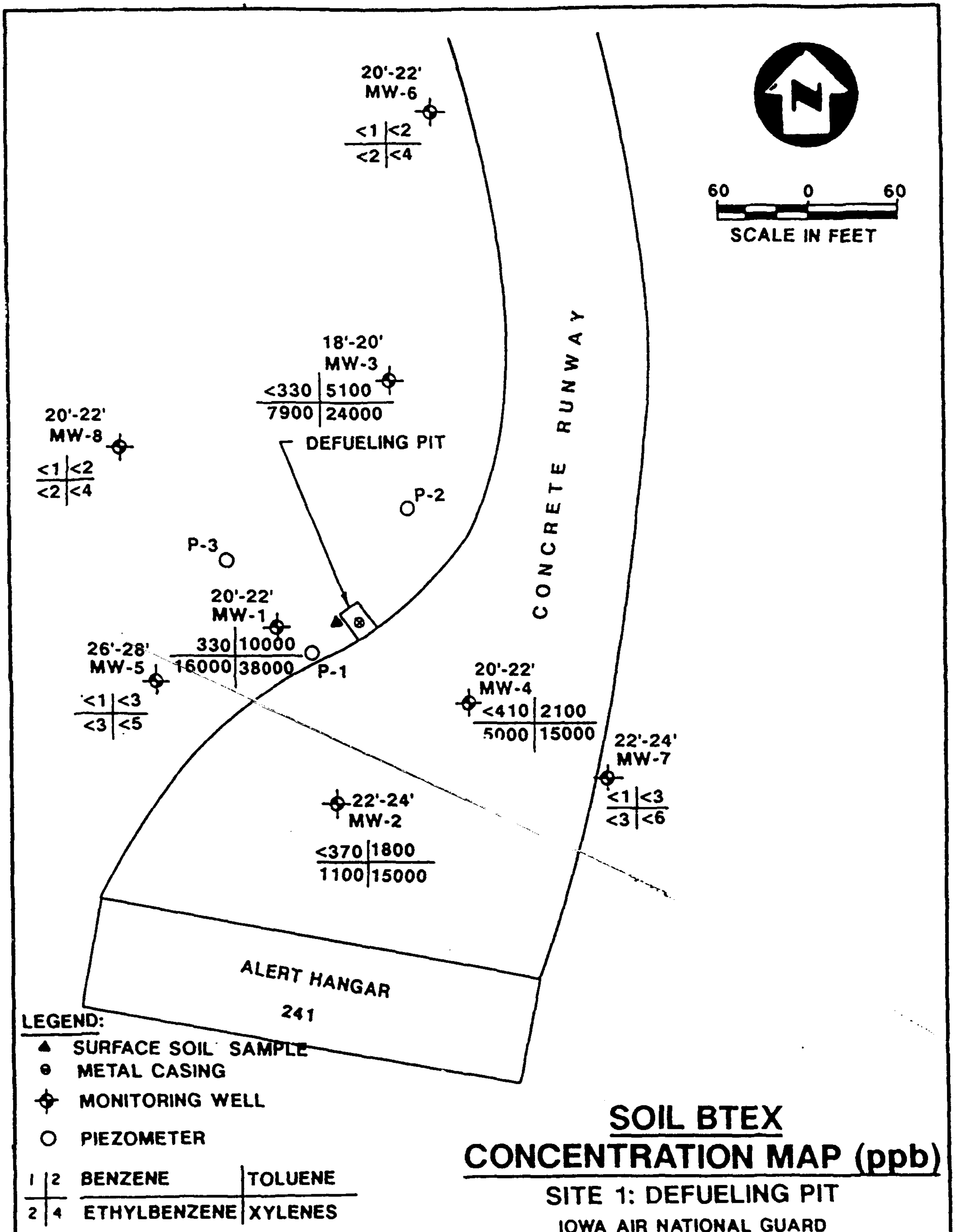
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

FIGURE 4.5



SOIL BTEX
CONCENTRATION MAP (ppb)

SITE 1: DEFUELING PIT
IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

## TABLE 4.3

## GROUNDWATER ELEVATIONS AND HYDROCARBONS THICKNESS
## SITE 1 - DEFUELING PIT

## IANG - SERGEANT BLUFF, IOWA

| Well[1] No. | Date | Well Cover[2] Elevation | Depth to Fluid (feet) | Depth to Water (feet) | Hydrocarbon Thickness (feet) | Corrected[3] Water Surface Elevation |
|---|---|---|---|---|---|---|
| MW-1 | 8/13/90 | 1092.29 | 23.40 | 25.60 | 2.20 | 1068.45 |
| MW-2 | 8/13/90 | 1093.38 | 25.02 | 25.02 | 0.00 | 1068.36 |
| MW-3 | 8/13/90 | 1091.25 | 22.28 | 24.55 | 2.27 | 1068.52 |
| MW-4 | 8/13/90 | 1092.81 | 23.82 | 26.10 | 2.28 | 1068.53 |
| MW-5 | 8/13/90 | 1092.95 | 24.58 | 24.58 | 0.00 | 1068.37 |
| MW-6 | 8/13/90 | 1091.41 | 22.87 | 22.87 | 0.00 | 1068.54 |
| MW-7 | 8/13/90 | 1092.87 | 24.44 | 24.44 | 0.00 | 1068.43 |
| MW-8 | 8/13/90 | 1091.09 | 22.70 | 22.70 | 0.00 | 1068.39 |

(1) Monitor well locations are shown on Figure 3.2.

(2) Elevations are in feet above mean sea level. Depths measured from rim of flush-mounted well cover.

(3) Water surface elevation correction: (hydrocarbon thickness x 0.8) + measured water surface elevation = corrected water surface elevation (after AFL Industries, General Engineering Data, No. 17-05.G.1)

## TABLE 4.4

## SOIL AND WATER SAMPLES SUBMITTED FOR LABORATORY ANALYSIS - SITE 1

## IANG - SERGEANT BLUFF, IOWA

| Location | Soil (Sample Depth) | Water | Analysis |
|---|---|---|---|
| MW-1 | (20 - 22) | ✓ | 8020, 8240, 418.1 |
| | (22 - 24) | | 8020, 8240, 418.1 |
| MW-2 | (22 - 24) | ✓ | 8020, 8240, 418.1 |
| | (24 - 26) | | 8020, 8240, 418.1 |
| MW-3 | (18 - 20) | ✓ | 8020, 8240, 418.1 |
| | (20 - 22) | | 8020, 8240, 418.1 |
| MW-4 | (20 - 22) | ✓ | 8020, 8240, 418.1 |
| | (24 - 25) | | 8020, 8240, 418.1 |
| MW-5 | (4 - 6) | ✓ | 8020, 8240, 418.1 |
| | (26 - 28) | | 8020, 8240, 418.1 |
| MW-6 | (8 - 10) | ✓ | 8020, 8240, 418.1 |
| | (20 - 22) | | 8020, 8240, 418.1 |
| MW-7 | (8 - 10) | ✓ | 8020, 8240, 418.1 |
| | (22 - 24) | | 8020, 8240, 418.1 |
| MW-8 | (16 - 18) | ✓ | 8020, 8240, 418.1 |
| | (20 - 22) | | 8020, 8240, 418.1 |

### TABLE 4.5
### DETECTED COMPOUNDS IN SOIL SAMPLES
### SITE 1 DEFUELING PIT
### IANG, SERGEANT BLUFF, IOWA

| SAMPLE ID: | IANG-1<br>SB-1-S1 | IANG-1<br>SB-1-S2 | IANG-1<br>SB-3/<br>MW-2-S1 * | IANG-1<br>SB-3/<br>MW-2-S2 * | IANG-1<br>SB-4/<br>MW-3-S1 * | IANG-1<br>SB-4/<br>MW-3-S2 * |
|---|---|---|---|---|---|---|
| Date Sampled: | 31-JUL-90 | 31-JUL-90 | 6-AUG-90 | 6-AUG-90 | 7-AUG-90 | 7-AUG-90 |
| **Volatile Organics (ug/kg)** | | | | | | |
| Benzene | 330 | 5000 J | 370 U | 110 U | 330 U | 380 U |
| Ethyl Benzene | 16000 | 44000 J | 1100 | 220 | 7900 | 17000 |
| Toluene | 10000 | 61000 J | 1800 | 220 U | 5100 | 12000 |
| Xylenes | 38000 | 100000 J | 15000 | 2200 | 24000 | 58000 |
| **Semi-Volatile Organics (ug/kg)** | | | | | | |
| Naphthalene | 820 | 1800 | 340 U | 400 U | 1100 | 2300 |
| 2-Methylnaphthalen | 1400 | 2500 | 340 U | 400 U | 1600 | 2500 |
| Dibenzofuran | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| Benzo(a)Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| Chrysene | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| Benzo(b)Fluoranthe | 340 U | 350 U | 340 U | 400 U | 340 U | 340 U |
| TPH (mg/kg) | 730 | 1700 | 10 U | 29 | 920 | 1600 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.
* SB-2 was not converted to a monitor well, thus the boring/well numbering sequence is offset, eg. SB-3 was converted to MW-2.
See Appendix H for complete analytical results

TABLE 4.5 continued
DETECTED COMPOUNDS IN SOIL SAMPLES
SITE 1 DEFUELING PIT
IANG, SERGEANT BLUFF, IOWA

| SAMPLE ID: | IANG-1 SB-5/ MW-4-S1 * | IANG-1 SB-5/ MW-4-S2 * | IANG-1 SB-6/ MW-5-S1 * | IANG-1 SB-8/ MW-7-S2 * | IANG-1 DEFUELING PIT |
|---|---|---|---|---|---|
| Date Sampled: | 8-AUG-90 | 8-AUG-90 | 9-AUG-90 | 11-AUG-90 | 15-AUG-90 |
| **Volatile Organics (ug/kg)** | | | | | |
| Benzene | 410 U | 5600 | 1 U | 1 U | 2 U |
| Ethyl Benzene | 5000 | 20000 | 3 U | 3 U | 3 U |
| Toluene | 2100 | 29000 | 3 U | 3 U | 3 U |
| Xylenes | 15000 | 53000 | 5 U | 6 U | 21 |
| **Semi-Volatile Organics (ug/kg)** | | | | | |
| Naphthalene | 190 J | 2700 | 410 U | 460 U | 520 U |
| 2-Methylnaphthalen | 560 | 2900 | 410 U | 460 U | 520 U |
| Dibenzofuran | 340 U | 140 J | 410 U | 460 U | 520 U |
| Fluoranthene | 340 U | 410 U | 410 U | 460 U | 440 J |
| Pyrene | 340 U | 410 U | 410 U | 460 U | 580 |
| Benzo(a)Anthracene | 340 U | 410 U | 410 U | 460 U | 290 J |
| Chrysene | 340 U | 410 U | 410 U | 460 U | 340 J |
| Benzo(b)Fluoranthe | 340 U | 410 U | 410 U | 460 U | 710 |
| TPH (mg/kg) | 780 | 3100 | 20 | 17 | 160 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.
* SB-2 was not converted to a monitor well, thus the boring/well numbering sequence is offset, eg. SB-3 was converted to MW-2.
See Appendix H for complete analytical results

One surface water sample was collected from the metal casing believed to be used to discharge JP-4 to the subsurface. The water sample was analyzed for volatiles, semi-volatiles and TPH. The results revealed detectable levels of benzene, toluene, ethylbenzene and xylenes (Figure 4.4). The analytical results are summarized in Table 4.6.

The groundwater samples were collected from monitor wells containing no phase-separated hydrocarbons. Wells IANG-1-MW-2, -5, -6, -7 and -8 were sampled and submitted for laboratory analyses. The results revealed concentrations of benzene, toluene, ethylbenzene and xylenes above detection limits in IANG-1-MW-2 and -5 (Table 4.6).

The JP-4 fuel fingerprint analysis results indicate both the hydrocarbon sample collected from MW-4 and the fresh JP-4 fuel collected from the JP-4 fuel storage truck are likely to be from similar producer distallation cuts. However, small differences are notable on the chromatograms regarding ratios of the major peaks, indicating that the two samples are from different manufacturing lots, and/or refineries. Both samples can be considered essentially unweathered JP-4 (Appendix K).

#### 4.3.3.4 Radiological Results

Soil samples collected from monitoring well 6 showed gross alpha concentration to be 35 pCi/g for a sample collected at 23 feet and 1.4 pCi/g for a sample collected at 27 feet. No obvious source material was observed in the boring and subsequent background samples taken at the UST site had gross alpha concentrations of 1.2 pCi/g and 1.6 pCi/g, respectively. The high value detected in MW-6 can most likely be considered an anomaly attributable to naturally occurring variations in the geology.

### 4.3.4 Preliminary Risk Evaluation

#### 4.3.4.1 Introduction

The preliminary risk evaluation provides an evaluation of the potential risks to human health and the environment posed by the contaminants detected at the two sites investigated during the SI at the Base. The data used in this evaluation was collected during the SI. The objectives of the preliminary risk evaluation are to provide qualitative information on the potential risks to human and environmental receptors due to the release or threat of release of hazardous substances from the two sites; to aid in

### TABLE 4.6
### DETECTED COMPOUNDS IN WATER SAMPLES
### SITE 1 DEFUELING PIT
### IANG, SERGEANT BLUFF, IOWA

| Sample ID: | IANG-1 MW-2 | IANG-1 MW-5 | IANG-1 DEFUELING PIT | IOWA ACTION LEVEL (1) |
|---|---|---|---|---|
| Date Sampled: | 15-Aug-90 | 15-Aug-90 | 15-Aug-90 | |
| **Volatile Organics (ug/l)** | | | | |
| Benzene | 3 | 180 | 3 | 1.0 |
| Ethyl Benzene | 2 U | 4 | 150 | ---- |
| Toluene | 2 U | 2 | 5 | 2,420 |
| Xylenes | 9 | 12 | 360 | 10,000 |
| **Semi-Volatile Organics (ug/l)** | | | | |
| 2,4-Dimethylphenol | 20 U | 20 U | 10 | ---- |
| TPH (mg/l) | 1 U | 1 U | 1 | ---- |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

(1) IOWA CRITERIA FOR ACTION LEVELS:

A- The HAL (lifetime Health Advisory Level) if one exists; if not

B- the NRL (Negligible Risk Level, risk of 10E-06 over lifetime) if one exists, if not

C- The MCL (Maximum Contaminant Level) if one exists, if not

D- A concentration level established by the Iowa Department of Natural Resources, based on literature recommended guidelines of EPA and experts on a case-by-case basis.

identifying additional data needed to complete a quantitative risk assessment during the RI; or to provide information for the determination that no further action is required if risks to human and environmental receptors are not identified.

The initial steps of the preliminary evaluation were to:

- Summarize the available chemical sampling data.
- Establish criteria for selecting chemicals that are or may be related to the site, and that may have an adverse affect on human health or the environment in the concentrations present.
- Review the factors that affect migration of contaminants, and identify and evaluate the potential migration pathways.
- Evaluate the potential toxicities associated with exposure to the selected chemicals by human or environmental receptors.
- Identify potential hazards to human or environmental receptors that may be affected by the migration of contaminants along identified pathways.

The SI is the initial investigation of a site and its purpose is to confirm or deny the presence of contamination. Therefore, detailed calculations to quantify risk to human health and the environment from the site were not performed. Instead, a qualitative approach was taken in which all potential receptors and exposure pathways were evaluated, and the potential importance of each exposure pathway was ascertained based on a comparison with standards or criteria and an evaluation of the likelihood of pathway completion. This evaluation was based on existing site information concerning migration pathways, the location and types of contaminants present, and the location of current and possible future receptors. Conservative assumptions were employed to insure that potential exposure pathways were not excluded from consideration.

### 4.3.4.2 Preliminary Human Health Evaluation

#### 4.3.4.2.1 Selection of Contaminants of Concern

During the selection of indicator chemicals, available information regarding the hazards of substances present at the site was evaluated. Data used in selecting chemicals of concern for this preliminary human health evaluation were compiled from the SI field work performed at the Installation. Compounds which were not detected in any samples were eliminated from further evaluation. Laboratory contaminants such as methylene chloride and acetone were eliminated from further consideration if they were

present in samples at concentrations less than ten times the highest concentration detected in the appropriate QA samples.

Contaminants detected in soil and groundwater samples from the two sites included volatile fuel components, petroleum hydrocarbons and polynuclear aromatic hydrocarbons.

Analytical data were reviewed by medium to characterize contamination at each of the two sites at the Installation. Not all compounds were detected at both sites or in all media. The maximum concentrations for each chemical provide an indication of the magnitude of chemical contamination in the analyzed samples. The maximum values are used in subsequent sections to estimate the potential for adverse health affects.

Toxicity information on the chemicals of concern for both human and environmental receptors is included in the following paragraphs. Also, included, when available, is information on environmental fate of each compound. The following polynuclear aromatic hydrocarbon (PNA) compounds are discussed as a group rather than as individual compounds: Benzo(a)anthracene, Benzo(b)fluoranthene, Chrysene, Dibenzofuran, Fluoranthene, Naphthalene, 2-methylnaphthalene, 2,4-Dimethylphenol and Pyrene.

**Benzene:** Benzene is a colorless aromatic hydrocarbon with a characteristic odor. Benzene was widely used in the past as a solvent and as an octane-raising additive in gasoline. Presently, benzene is used primarily in the chemical industry as a starting or intermediate material for the synthesis of many other organic compounds.

Benzene has been shown to be mobile in the soil/groundwater system. It is relatively soluble in groundwater and may be transported through sandy soils and soils of low organic content. The amount of benzene sorbed to the soil increases with increasing organic content. Benzene is highly volatile, and volatilization in surficial soils is probably an important transport mechanism. However, sorption of benzene vapors onto soil particles may slow vapor-phase transport. Data on the biodegradation of benzene are inconclusive. There is some evidence of gradual biodegradation at low concentrations by aquatic organisms, but the compound is considered fairly resistant to biodegradation. The rate of biodegradation may be enhanced in the presence of other hydrocarbons.

Benzene is readily absorbed following oral and inhalation exposure. The toxic effects of benzene in humans following exposure by inhalation is the same as that for laboratory animals, and includes central nervous system effects, hematological effects, and immune system depression. In humans, acute exposures to high concentrations of benzene vapors has been associated with dizziness, nausea, vomiting, headache, drowsiness, narcosis, coma, and death. Chronic exposure to benzene vapors can produce reduced leukocyte, platelet, and red blood cell levels.

Chronic exposure to benzene is associated with leukemia and bone marrow damage. In addition, the compound is a central nervous system depressant at high concentrations, and may cause acute narcotic reactions. Benzene has been classified a Group A human carcinogen by U.S. EPA.

Data are not considered sufficient to develop ambient water quality criteria for benzene. No information is available on the toxicity of benzene to terrestrial wildlife, domestic animals, or birds. Toxic effects in laboratory animals include central nervous system effects, hematological effects, and immune system depression.

**Toluene:** Toluene is a monocyclic aromatic, colorless liquid. It is used in manufacturing benzoic acid, benzaldehyde, explosives, dyes, and many other organic compounds. Toluene functions as a solvent in products such as wood furniture cleaners.

From the available data, it appears that volatilization is the major route of removal from aquatic environments. Once volatilized, atmospheric photodestruction of toluene probably subordinates all other fates. Toluene will be adsorbed by sediments and suspended solids, but the degree to which this adsorption will interfere with volatilization is unknown. Toluene does not bioaccumulate in the environment.

Toluene in low-levels may irritate both the skin and eye and may cause impairment of coordination and reaction time when inhaled at low-levels. Higher levels of exposure may result in additional symptoms such as headaches, nausea, and loss of appetite. Acute poisoning is rare, but chronic poisoning occasionally results in anemia and leucopenia.

**Ethylbenzene:** Ethylbenzene is a colorless aromatic liquid. It is used in industry as a resin solvent and in the conversion to styrene monomer. No empirical studies on

the bioaccumulation of ethylbenzene were found. No information on the toxicity of ethylbenzene to terrestrial wildlife or birds was available.

Ethylbenzene is moderately adsorbed to soils but it will leach to groundwater, particularly in soils containing low levels of organic matter. Ethylbenzene will volatilize from surface soils and it is thought that it will biodegrade once microbial populations become acclimated (Howard, 1980).

**Polynuclear Aromatic Hydrocarbons:** PNAs, also termed polycyclic aromatic hydrocarbons (PAHs) are a class of chemical compounds characterized by a basic structure of two or more fused aromatic (benzene) rings. The compounds are fused by pairs of carbon atoms, resulting in a molecule with a carbon atom lying in a single plane with hydrogen atoms. The lowest molecular weight member of this group is naphthalene, with two fused rings. The highest molecular weight member is graphite. PNA compounds can be divided into two groups based on their chemical, physical and biological properties. These two groups are the lower molecular weight (two- to three-ring) compounds and the higher molecular weight (four- to seven-ring) compounds.

The physical properties of PNAs typically vary with increasing molecular weight. Vapor pressure and solubility decrease almost logarithmically with increasing molecular weight. Resistance to reduction and oxidation typically decreases with increasing molecular weight. These trends help to explain why the lower-ring-numbered and higher-ring numbered compounds differ substantially in their behavior and distribution in the environment.

PNAs have been noted to be ubiquitous in the environment. In the past, PNA compounds were typically thought to result only from high-temperature pyrolysis of organic materials. Although this is the principal means of PNA generation, it has more recently been shown that low-temperature transformation of sedimentary organic material to form fossil fuels, as well as direct biosynthesis by microbes and plants, are additional sources of PNAs. Anthropogenic sources also increase the loading of PNAs into the environment. This includes industrial activities such as coke and coal gas production, gas production from petroleum, oil refining, and preparation of acetylene from natural gas. Other sources include incineration of domestic and industrial wastes, power generation from fossil fuels, and automobile exhaust.

PNA compounds vary substantially in their acute toxicity to aquatic animals. In general, toxicity to species will increase with increasing molecular weight. However, the higher-ring-numbered PNAs have low acute toxicity, apparently due to their low solubilities. In most cases, crustaceans are the most sensitive species, polychaete worms are intermediate in sensitivity, and fish are the most resistant. Acute toxicity levels in water are several orders of magnitude higher than levels found in even the most polluted marine and freshwaters. Sediment levels typically approach concentrations similar to the acutely toxic level, however, being bound to the sediment renders PNAs considerably less toxic.

Biodegradation is thought to be the primary fate of PNAs in the environment. Some PNA compounds have been noted to be highly toxic, carcinogenic, mutagenic, and/or teratogenic to many species. PNAs have demonstrated toxicity via the oral and dermal routes, indicating that they are capable of passage across epithelial membranes. Additionally, research indicates that they are easily absorbed through the lungs. They tend to concentrate initially in the liver and kidneys until they are excreted. They eventually move to organs containing or surrounded by fat (e.g., mammary glands, adrenals).

**Xylenes:** Xylenes are mixtures of the ortho-, meta-, and para-dimethyl benzenes, with the meta-form usually the principal component. Xylenes may also contain 6 to 10 percent impurities such as benzene, ethyl benzene, trimethylbenzene, toluene, phenol, thiophene, pyridene, and nonaromatic hydrocarbons. Xylenes are widely used as fuel components and as solvents for inks, rubbers, gums, resins, adhesives, lacquers, paints, and insecticides. Xylenes are commonly used in the chemical industry as intermediates. Specifically, ortho-xylene is used in the manufacture of phthalic anhydride, which is a basic building block for plasticizers. Meta-xylene is an intermediate in the preparation of isophthalic acid, which is the base of unsaturated polyester resins. Commercially, para-xylene is the most important isomer, most of which is converted to terephthalic acid or dimethylterephthalate and used to make fibers, films, and resins.

The primary exposure pathway of concern from soil/water systems is the migration of xylenes into groundwater used for drinking water supplies. Inhalation resulting from volatilization from surface soils may also be important. Xylenes are relatively mobile in soil/water systems, especially in the aqueous phase. Volatilization is

also possible. The chemical is resistant to hydrolysis but is probably biodegradable. Xylenes could persist for months to years.

### Petroleum Hydrocarbons

Petroleum hydrocarbons are a group of compounds that are thick, dark yellow to brown, or green-black liquids which consist of a mixture of hydrocarbons from $C_2H_2$ and up. They are used as a source of gasoline, petro ether, petrolatum, fuel and lubricating oils, butane, and isopropyl alcohol. Gasoline, jet fuel, and mineral spirits are the petroleum hydrocarbons of primary concern in this risk evaluation.

Hydrocarbon-containing petroleum residues are decomposed in soil systems. Hydrocarbons degrade to carbon dioxide and water via several intermediates (organic acids, ketones, aldehydes, alcohols, and other hydrocarbon derivatives). Nonvolatile components of oils tend to stay tightly bound in soil, while volatile fractions may escape into the atmosphere. No significant loss or movement of oil through surface runoff from rainfall or downward leaching occurs.

Gasoline is an aspiration hazard, defats the skin, and has been shown to cause kidney tumors in laboratory animals. It contains benzene and toluene which may be absorbed through the skin. Benzene is a cancer hazard that affects the blood. Primary routes of exposure are inhalation and skin contact. Eye contact with liquid gasoline may cause burning, tearing, redness, and transient corneal damage. Prolonged or repeated dermal contact may cause burning, redness, drying and cracking of the skin, and dermatitis. Exposure to mist or excessive vapor concentration may cause irritation of the nose, throat, and upper respiratory tract. Severe exposures may result in unconsciousness, coma, and death. Ingestion of gasoline may cause signs of central nervous system depression, headache, nausea, drowsiness, and dizziness.

Fuel oil is a combustible liquid and a skin irritant. Breathing oil mists may irritate the nose and throat. Chronic exposure to oil mists may lead to the development of lipoid pneumonia. Similarly refined and processed petroleum residual materials have been shown to cause skin cancer and liver damage in laboratory animals through prolonged skin contact. There is no direct evidence that fuel oil causes skin cancer or liver damage in humans.

### 4.3.4.2.2 Environmental Fate and Transport

An evaluation of the environmental fate and transport of the selected chemicals of concern for Iowa ANGB can help determine the potential for migration in the environment and the potential for exposure to the contaminants. The environmental fate and transport of contaminants is dependent upon the physical and chemical properties of the compounds, the environmental transformation processes affecting them, and the media through which they migrate. In this section, the chemical and physical properties of the chemicals of concern are presented, and the relevance of these properties to environmental fate and transport is discussed. In addition, mechanisms of chemical migration into air, groundwater, and surface water and processes of biotransformation and bioaccumulation are discussed in relation to the environmental fate and transport of the chemicals of concern.

#### Environmental Setting

The environmental setting is discussed in detail in Section 2.

#### Chemical and Physical Properties of the Chemicals of Concern

Physical and chemical properties of the chemicals of concern will affect fate and transport of those chemicals in the environment. Table 4.7 summarizes several important physical and chemical properties for many of the selected chemicals of concern.

The water solubility of a substance is a critical property affecting environmental fate. Highly-soluble chemicals can be rapidly leached from wastes and soils and are generally mobile in groundwater. Solubilities can range from less than 1 mg/L to totally miscible, with most common organic chemicals falling between 1 mg/L and 1,000,000 mg/L [Lyman et al., 1982]. The solubility of chemicals which are not readily soluble in water may become enhanced in the presence of organic solvents (e.g., toluene), which themselves are more soluble in water. As shown in Table 4.7, benzene has the highest solubility of any of the contaminants found on the Base. Because of its relatively high solubility (greater than 1000 mg/L) these compounds are expected to be mobile in the soil.

Volatilization of a compound will depend on its vapor pressure, water solubility, and air diffusion coefficient. Highly water-soluble compounds generally have lower

## TABLE 4.7

## RELEVANT PHYSICAL AND CHEMICAL PROPERTIES OF INDICATOR CHEMICALS$^{(a)}$

| Indicator | CAS Number | Water Solubility$^{(h)}$ (mg/l) | Vapor Pressure$^{(h)}$ (mm Hg) | Henry's Law Constant (atm-m$^3$/mol) | Koc (ml/g) |
|---|---|---|---|---|---|
| Benzene | 71-43-2 | 1.75E+03 | 9.52E+01 | 5.59E-03 | 83 |
| Benzo[a]anthracene | 56-55-3 | 5.70E+03 | 2.20E-08 | 1.16E-06 | 1,380,000 |
| Benzo[b]fluoranthene | 205-99-2 | 1.40E+02 | 5.00E-07 | 1.19E-05 | 550,000 |
| Chrysene | 218-01-9 | 1.80E-03 | 6.30E-09 | 1.05E-06 | 200,000 |
| Dibenzofuran | 132-64-9$^{(g)}$ | 10 ppm$^{(i)}$ | 4.4E-03 | -- | -- |
| Ethylbenzene | 100-41-4 | 1.52E+02 | 7.00E-00 | 6.43E-03 | 1,100 |
| Fluoranthene | 206-44-0 | 2.06E-01 | 5.00E-06 | 6.46E-06 | 38,000 |
| 2-Methylnaphthalene | 91-57-6$^{(i)}$ | NS$^{m}$ | 6.81-02$^{(i)}$ | -- | -- |
| Naphthalene | 91-20-3 | 3.3E+01$^{c}$ | 2.3E-1$^{c}$ | 1.15E-3$^{c}$ | -- |
| Pyrene | 129-00-0 | 1.32E-01 | 2.50E-06 | 5.04E-06 | 38,000 |
| Toluene | 108-88-3 | 5.35E-02 | 2.81E-01 | 6.37E-03 | 300 |
| Xylene | 1330-20-7 | 1.98E+02 | 1.00E+01 | 7.04E-03 | 240 |

(a) Source: U.S. EPA, 1986, unless otherwise stated
(b) A = Human Carcinogen; B1, B2 = Probable Carcinogen;
C = Possible Carcinogen; d = Not classified
(c) Source: Lyman, 1985
(d) ATSDR Draft Toxicological Profile
(e) Source: NIOSH, 1985
(f) Source: SAX, 1987
(g) Source: IRIS, 1991
(h) Measured in temperature range 20-30 ° C unless otherwise noted.
(i) HSDB = National Library of Medicine
CAS = Chemical Abstract System

| | |
|---|---|
| mg/L | Milligrams per liter |
| mmHg | Millimeters of mercury |
| atm-m3/mol | Atmosphere-cubic meter per mole |
| ml/g | Milliliters per gram |
| Koc | Organic carbon partition coefficient |
| NR | Not relevant |
| l/kg | Liters per kilogram |

volatilization rates from water unless they also have high vapor pressures. Vapor pressure, a relative measure of the volatility of chemicals in their pure state, ranges from roughly 0.001 to 760 millimeters of mercury (mm Hg) for liquids. The Henry's Law Constant, which combines vapor pressure with solubility, is more appropriate than vapor pressure alone for estimating releases from water to air for compounds having Henry's Law Constants. Compounds with Henry's Law Constants greater than 10-3 atmospheres-cubic meter per mole (atm-m3/mole) can be expected to readily volatilize from water; those with values ranging from 10-3 to 10-5 are associated with moderate volatilization, while compounds with values less than 10-5 will only volatilize from water to a limited extent [Lyman et al., 1982].

The organic carbon partition coefficient (Koc) reflects the propensity of a compound to sorb to organic matter found in soil. The normal range of Koc values is 1 to 107 milliliters per gram (mL/g). Chemicals which have a strong tendency to sorb to organic matter (i.e., chemicals with high Koc values) will move more slowly in the environment than chemicals with low Koc values. The polynuclear aromatic hydrocarbons and dichlorobenzenes have the highest Koc values of any compounds identified at the Base. These compounds would therefore be expected to be strongly adsorbed by organic matter present in the soil and have relatively low mobilities.

Chemicals of concern were classified into several categories according to their similarity in chemical structure and/or physiochemical properties (factors which would influence mobility in the environment) as follows:

- volatile organics: benzene, ethyl benzene, toluene, xylenes.
- semivolatile organics: benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenzofuran, fluoranthene, pyrene, 2-methylnaphthalene, naphthalene, 2,4-dimethylphenol.
- other: TPH.

Each of these categories are discussed below with respect to how their properties affect the persistence and transport of these compounds in the envrionment.

### Volatile Organics

Volatile organic compounds are low molecular weight compounds whose presence in soil and water samples collected at the Installation is due to their widespread use as fuel. These compounds generally have high Henry's Law Constants,

moderate to high solubilities and low Koc values. This indicates that these compounds can be expected to be mobile in the environment.

The soils at the Installation consist primarily of silts and silty clays. Groundwater at the Installation is between 22 and 25 feet deep and the migration of these compounds to the groundwater is possible. As described in Section 4, several of these compounds have been detected in the groundwater at the site.

The properties that enhance the mobilities of these compounds also make them more available for degradation. Because of their high vapor pressures these compounds would be expected to volatilize from surface soils.

### Semi-Volatile Organics

Semi-volatile organic compounds detected in soil collected at Site 1 consisted of polynuclear aromatics (PNAs). One phenolic compound was detected in the groundwater. The semi-volatile organics have higher molecular weights than the volatile compounds. They also have lower vapor pressures, lower solubilities, and higher Koc values. These compounds are expected to be strongly adsorbed by site soils and therefore less mobile in the environment. While the semi-volatile compounds are not soluble in water, they are soluble in non-water solvents such as fuels. The application of fuels to the ground could enhance the mobility of these compounds.

### Petroleum Hydrocarbons

Petroleum hydrocarbon concentrations are measured using fluorocarbon-113 extraction of organic compounds with medium to high molecular weights. Low molecular weight compounds and light fuels, such as gasoline, volitize during the analysis and, therefore, have low recoveries. The aliphatic organics which constitute most of the recoverable petroleum hydrocarbons are generally less toxic than the volatile organic compounds. The primary health concern associated with chronic exposure is through ingestion of contaminated food and water.

The fate of petroleum hydrocarbons in soils is affected primarily by their distribution, volatility, and leaching potential. Low molecular weight aromatic hydrocarbons such as benzene, toluene, and xylenes partially evaporate. The remaining hydrocarbons will migrate to different depths in the soil column and possibly to groundwater.

The aliphatic organics which represent the residual compounds have negligible water solubilities, low vapor pressures and high adsorption coefficients. The proportion of petroleum hydrocarbons that will adsorb to soil particles rather than continue migration depends on the type of soil, the particular petroleum product involved, the volume of the release, and the amount of rainfall. In general, leaching to groundwater is favored by high rainfall and permeable soils, and increases for petroleum compounds with high solubility and low adsorption coefficients.

Most compounds measured as petroleum hydrocarbons are relatively persistent in the environment. Biodegradation is the main elimination mechanism, but rates are fairly slow, especially for cyclic or aromatic hydrocarbons. Complete biodegradation of petroleum hydrocarbons may require many years or decades [API, 1986].

#### 4.3.4.2.3 Exposure Assessment

The presence of a contaminant in a particular environmental medium does not necessarily indicate that human exposure will occur. In order for human exposure to occur, a complete exposure pathway must exist. A complete exposure pathway consists of the following:

- a contaminant source and mechanism for release;
- an environmental transport medium;
- an exposure point; and
- a human receptor and a feasible route of exposure at the exposure point.

If any of the items listed above are missing then an exposure pathway is incomplete. The following paragraphs describe the transport mechanism and exposure pathways for the two sites at the Installation.

**Mechanisms of Migration**

The media into which a contaminant migrates affects the types of human and environmental exposures which may occur. The previous subsections have described the physical and chemical properties of concern. This subsection discusses the mechanisms of contaminant migration and potential exposure routes for the Installation.

Contaminants have been detected in groundwater and soil at Site 1. Several mechanisms exist through which contaminants from these areas may migrate.

Migration into Air. Contaminants may migrate into the air through three primary mechanisms: volatilization; soil gas migration; and suspension of soil particles (wind erosion or mechanical disturbances).

Volatilization is the mass transfer of a compound from a specific medium (soil or water) to the air. Environmental factors that affect volatilization include temperature, soil porosity, soil water content, soil organic carbon content, and depth of contamination. Volatilization may be an important migration pathway for contaminants having high vapor pressures (greater than 100 mm Hg) or high Henry's Law Constants (greater than 10-3 atm-m-3/mole). Contaminants detected at Site 1 which are in this category include the aromatics (benzene, xylenes, toluene, etc.). Some other chemicals of concern while having lower vapor pressures may still have a tendency to volatilize. The polynuclear aromatic hydrocarbons (PAHs) fall in this category. Volatilization is not a potential migration pathway for Site 1 since volatile organic compounds and PAHs are present in subsurface soils.

The migration of chemicals into soil gas is controlled by factors similar to those that control volatilization. Soil gas samples collected at Site 1 identified the presence of contaminants indicating that this soil gas migration is a potential migration pathway for these sites.

Fugitive dust emissions from wind or vehicle disturbances is not possible because affected soils are below the surface.

**Leaching into Groundwater.** The percolation of rainwater through the soils at the four sites could leach soil contaminants into the groundwater. Since groundwater contamination has been detected at Site 1, it appears that this has already occurred.

Once contaminants have reached the groundwater the different contaminants will have different migration rates. Compounds with low water solubilities and high organic carbon partition coefficients, such as the semi-volatile compounds will be transported in the direction of groundwater flow but at a slower rate than the groundwater. The volatile organic compounds which have much higher solubilities and lower Koc values will have higher mobilities in the groundwater.

**Migration in Ponded Water.** Contaminant migration into ponded water is unlikely since affected soils are below the surface.

**Identification of Exposure Pathways.**

Potential exposure pathways for Site 1 are summarized in Table 4.8.

The property around Site 1 has restricted access to Installation personnel only by means of locked fences. Adjacent property is used primarily for agriculture, in particular corn crops. There are several farms within a mile radius of each site. The water supply source of these dwellings is undocumented, although it is most likely that they have private wells. The closest dwelling is approximately ¼-mile to the south of Site 1. Groundwater flow direction is believed to flow generally to the southwest.

Future land use will remain the same according to the Master Plan for Sious Gateway Airport. No residential development is planned.

The present property agreement is between the City of Sioux City, Iowa and the Department of the Air Force (License for National Guard Purposes, Form 1 May 63). The agreement commenced 1 July 1969 and expires 20 June 2019. The agreement automatically renews annually until the expiration date, unless the Government exercises its right to give notice to termination. The agreement provides for the exclusive use of buildings and parcels of land located on the Sious Gateway Airport, together with all roads, sidewalks, railroads, utilities, drainage ditches, sewer lines, aprons, buildings and structures and tools, equipment and fixtures, on 11 parcels which are lettered and listed within the agreement.

Current pathways include exposure to air, groundwater, surface water and soils by Installation personnel, visitors, trespassers and nearby residents. The possibility of air and soil pathways is very low since affected soils are below the surface.

Groundwater is not used by the Installation, but is not known exactly for what purpose the local farmers use their wells. However, there is low possibility of exposure due to limited contamination.

Future pathways are limited since land use is expected to remain the same. Contaminant migration to downgradient wells may occur but may be offset by other mechanisms such as degradation. Construction workers may be exposed to affected soil. However, construction in the area of Site 1 is unplanned and unlikely.

## TABLE 4.8

## MATRIX OF POTENTIAL EXPOSURE PATHWAYS
## SITE 1 - IOWA AIR NATIONAL GUARD

| Transport Medium | Release Source or Mechanism | Primary Exposure Point | Potential Receptors | Primary Exposure Route | Probability of Pathway Completion |
|---|---|---|---|---|---|
| <u>Current Use</u> | | | | | |
| Air | Affected soils/ fugitive dust generation, volatilization | Areas downwind of Site 1. | Base personnel, trespassers, local farmers | Inhalation, dermal | None: affected soils are below the subsurface. |
| Groundwater | Affected soils, groundwater | Wells used for drinking water or irrigation | Local farmers | Ingestion, Inhalation, Dermal | Low: affected groundwater is limited to the immediate vicinity of Site 1. |
| | | | Base personnel | Ingestion, Inhalation, dermal | None: Water is supplied to the Base from the City of Sioux City which is supplied by distant wells. |
| Soils | Affected soils, groundwater/site leaching, runoff, tracking | Surface soils | Base personnel, local farmers, trespassers | Ingestion, dermal | None: Surface soils are not affected, site access is limited and Site 1 is infrequently visited. |

## TABLE 4.8 (continued)

## MATRIX OF POTENTIAL EXPOSURE PATHWAYS
## SITE 1 - IOWA AIR NATIONAL GUARD

| Transport Medium | Release Source or Mechanism | Primary Exposure Point | Potential Receptors | Primary Exposure Route | Probability of Pathway Completion |
|---|---|---|---|---|---|
| <u>Future Use</u> | | | | | |
| Groundwater | Affected soils, groundwater | Downgradient wells used for drinking or irrigation | Local farmers | Ingestion, inhalation, dermal | Low: Affected groundwater may migrate to downgradient wells, but concentrations may decrease due to degradation, volatilization, etc. |
| Soils | Affected soils<br>irrigation | Soils at the site | Construction workers | Ingestion, inhalation, dermal | Low: Future construction in contaminated areas is not planned, but is possible. |

### 4.3.4.2.4 Toxicity Assessment

The objective of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. The types of toxicity information considered in this assessment include the slope factor to evaluate carcinogenic potential and the reference dose (RfD) used to evaluate noncarcinogenic effects.

#### Health Criteria for Carcinogenic Effects

For chemicals that exhibit carcinogenic effects, most authorities recognize that one or more molecular events can evoke changes in a single cell or a small number of cells that can lead to tumor formation. This is the nonthreshold theory of carcinogenesis which purports that any level of exposure to a carcinogen can result in some finite possibility of generating the disease. Generally, regulatory agencies assume the nonthreshold hypothesis for carcinogens in the absence of information concerning the mechanisms of action for the chemical.

EPA's Carcinogen Assessment Group (CAG) has developed slope factors (i.e., dose-response values) for estimating excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. The carcinogenic slope factors can be used to estimate the lifetime excess cancer risk associated with exposure to a potential carcinogen. Risks estimated using slope factors are considered unlikely to underestimate actual risks, but they may overestimate actual risks. Excess lifetime cancer risks are generally expressed in scientific notation and are probabilities. An excess lifetime cancer risk of 1x10-6 represents the probability that one individual out of one million will develop cancer as a result of exposure to a carcinogenic chemical over a 70-year lifetime under specified exposure conditions. EPA has suggested developing remedial alternatives for cleanup of Superfund sites using total excess lifetime cancer risks ranging from 10-4 to 10-6.

In practice, slope factors are derived from the results of human epidemiology studies or chronic animal bioassays. The data from animal studies are generally fitted to the linearized multistage model and dose-response curve is obtained. The 95th percentile upper confidence limit slope of the dose-response curve is subjected to

various adjustments and an interspecies scaling factor is applied to conservatively derive the slope factor for humans. Thus, the actual risks associated with exposure to a potential carcinogen quantitatively evaluated based on animal data are not likely to exceed the risks estimated using these slope factors, but they may be much lower. Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an ad hoc basis. These models provide rough but plausible estimates of the upper limits on lifetime risk. Slope factors based on human epidemiological data are also derived using very conservative assumptions and, as such, they too are considered unlikely to underestimate risks. In summary, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using a slope factor, they could be considerably lower.

In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. EPA has proposed a system for characterizing the overall weight of evidence for a chemical's carcinogenicity based on the availability of animal, human, and other supportive data [EPA, 1986a]. The weight-of-evidence classification is an attempt to determine the likelihood that an agent is a human carcinogen and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for carcinogenicity: (1) the quality of evidence from human studies and (2) the quality of evidence from animal studies, which are combined into a characterization of the overall weight of evidence for human carcinogenicity; and (3) other supportive information which is assessed to determine whether the overall weight of evidence should be modified. EPA's final classification of the overall weight of evidence includes the *following five categories:*

- Group A - - Human Carcinogen

  This category indicates that there is sufficient evidence from epidemiological studies to support a casual association between an agent and cancer.

- Group B - - Probable Human Carcinogen

  This category generally indicates that there is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

- Group C - - Possible Human Carcinogen

  This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans.

- Group D - - Not Classified

This category indicates that the evidence for carcinogenicity in animals is inadequate.

- Group E - - No Evidence of Carcinogenicity to Humans

  This category indicates that there is no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies.

Slope factors are developed based on epidemiological or animal bioassay data for a specific route of exposure, either oral or inhalation. For some chemicals, sufficient data are available to develop route-specific slope factors for inhalation and ingestion. For chemicals with only one route-specific slope factor but for which carcinogenic effects may also occur via another route, EPA has used the available value to evaluate risks associated with both potential routes of exposure.

Several of the selected chemicals of concern have been classified as potential carcinogens by EPA. Some of these chemicals are:

Group A - - Human Carcinogens
Benzene

- Group B - - Probable Human Carcinogens

  Benzo(a)Anthracene
  Benzo(b)Fluoranthene
  Chrysene

- Group C - - Possible Human Carcinogens

  2-Methylnapthalene

Potential carcinogenic effects and slope factors for chemicals of concern identified at the Base are shown in Table 4.9.

### Health Criteria for Noncarcinogenic Effects

For chemicals that exhibit noncarcinogenic effects, many authorities consider organisms to have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is seen. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects.

# TABLE 4.9

## TOXICITY CONSTANTS FOR CHEMICALS OF CONCERN
## POTENTIAL CARCINOGENIC EFFECTS
## SITE 1 - IOWA AIR NATIONAL GUARD

| Chemical | Slope Factor 1/(mg/kg/day) |  | Weight of Evidence Classification |  | Tumor Site |  |
|---|---|---|---|---|---|---|
|  | Inhalation | Oral | Inhalation | Oral | Inhalation | Oral |
| Benzene | 2.9E-02 | 2.9E-02 | A | A | Blood Cells | Blood Cells |
| Benzo[a]anthnacene | NA | NA | B2 | B2 | NA | Total Tumors |
| Benzo[b]fluoranthene | NA | NA | B2 | B2 | NA | NA |
| Chrysene | NA | NA | B2 | B2 | Lung | NA |
| 2-Methylnapthalene | NA | NA | NA | NA | NA | NA |

| | |
|---|---|
| NA - | Not Available |
| A - | Human Carcinogen |
| B2 - | Probable human carcinogen. Sufficient evidence in animals and inadequate or no evidence in humans. |

Health Criteria for chemicals exhibiting noncarcinogenic effects for use in risk assessment are generally developed using EPA RfDs. In general, the RfD is an estimate of route-specific average daily intake (dose) for individuals (including sensitive individuals) below which there will not be an appreciable risk of adverse health effects. The RfD is derived using conservative safety factors (e.g., to adjust from animals to humans and to protect sensitive subpopulations) to ensure that it is unlikely to underestimate the potential for adverse noncarcinogenic effects to occur. The purpose of the RfD is to provide a benchmark against which the sum of other doses (e.g., those projected from human exposure to various environmental conditions) might be compared. Doses that are significantly higher than the RfD may indicate an inadequate margin of safety could exist for exposure to that substance and that an adverse health effect could occur.

EPA has developed oral and inhalation RfDs for many of the chemicals of concern selected for the Installation. In addition, the chemicals of concern may affect different target organs in the body. Some of the chemicals of concern that may have noncarcinogenic effects following long-term exposure, and the target organs that are most sensitive to these chemicals, are as follows:

- Chemicals That May Adversely Affect The Liver
    - Fluoranthene
    - Ethylbenzene
    - Xylenes
    - Naphthalene
    - Toluene
- Chemicals That May Adversely Affect the Kidney
    - Ethylbenzene
    - Pyrene
    - Toluene
    - Fluoranthene
- Chemicals That May Adversely Affect the Nervous System
    - Toluene
    - Xylene
    - Naphthalene
- Chemicals That May Adversely Affect the Blood
    - Benzene
    - Fluoranthene
- Chemicals That May Adversely Affect Other Systems
    - Naphthalene may cause ocular lesions.
    - Total xylenes may cause reproductive effects.

Potential noncarcinogenic effects with RfDs of chemicals of concern identified at the Installation are shown on Table 4.10.

## TABLE 4.10

## TOXICITY CONSTANTS FOR CHEMICALS OF CONCERN
## POTENTIAL NONCARCINOGENIC EFFECTS
## SITE 1 - IOWA AIR NATIONAL GUARD

| Chemical | Chronic RfD (mg/kg/day) |  | Critical Effect |  |
|---|---|---|---|---|
|  | Inhalation | Oral | Inhalation | Oral |
| Dibenzofuran | NA | NA | NA | NA |
| Ethylbenzene | NA | 1.0E-01 | NA | Kidney, liver toxicity |
| Fluoranthene | NA | 4.0E-02 | NA | Nephropathy, increased liver weight, hematological altering |
| Naphthalene | NA | 4.0E-03H | NA | Decreased body weight gain |
| Pyrene | NA | 3.0E-02 | NA | Renal tubular pathology, decreased kidney weight |
| Toluene | 2.0E+00H | 2.0E-01 | Eye irritation<br>nose irritation<br>CNS effects | Change in liver and kidney weight |
| Xylenes | 3.0E-1 | 2.0E+00 | Hepatomegaly | Hyperactivity, decreased body weight, increased mortality |
| TPH | -- | -- | -- | -- |

RfD - Reference Dose
NA - Not Available

No RfDs or slope factors are available for the dermal route of exposure. In some cases, however, noncarcinogenic or carcinogenic risks associated with dermal exposure can be evaluated using an oral RfD or an oral slope factor. Exposures via the dermal route generally are calculated and expressed as absorbed doses. These absorbed doses are compared to an oral toxicity value that is also expressed as an absorbed dose. This requires quantitative estimates of both oral and dermal exposure and is only appropriate for chemicals causing systemic toxicity.

#### 4.3.4.2.5 Risk Screening

In evaluating the degree of contamination at a site, consideration must be given to applicable or relevant and appropriate requirements (ARARs) of Federal and State environmental laws. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that specifically address a hazardous substance, contaminant, remedial action, or other circumstance at a site. Relevant and appropriate requirements are those standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that, while not "applicable", address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site.

Potential ARARs for water quality at the Installation include the Safe Drinking Water Act, the Clean Water Act and State policies. Standards and criteria promulgated under these programs are provided in Table 4.11 for potential contaminants of concern at the Installation.

#### Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates EPA to establish regulations to protect human health from contaminants in drinking water. EPA has promulgated drinking water standards which generally apply to community water systems. Primary drinking water standards include maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs). MCLs are set at levels that are protective of human health, while taking into account available treatment technologies and the costs to large public water systems. MCLGs are strictly health-based and do not take cost or feasibility into account. Secondary drinking water regulations consist primarily of secondary maximum contaminant levels (SMCLs) for specific contaminants or water

## TABLE 4.11

## APPLICABLE OR RELEVANT APPROPRIATE REQUIREMENTS
## STANDARDS AND CRITERIA FOR COMPOUNDS DETECTED AT SITES 1 AND 2
## SITE 1 - IOWA AIR NATIONAL GUARD

| Criteria(2) | Safe Drinking Water Act(1) Current MCL ($\mu$g/l) | Proposed MCL | Current MCLG | Proposed MCLG | Water Quality Criteria(2) Drinking Water Only ($\mu$g/L)(4) | Iowa Action Level(5) Groundwater ($\mu$g/L) |
|---|---|---|---|---|---|---|
| Benzene | 5 | -- | 0 | -- | 0(0.67) | 1.0 |
| Benzo[a]anthracene | 0.1 | -- | -- | -- | 0)0.0031) | -- |
| Benzo[b]fluoranthene | 0.2 | -- | -- | -- | 0(0.0031) | -- |
| Chrysene | 0.2 | -- | -- | -- | 0(0.0031) | -- |
| Dibenzofuran | -- | -- | -- | -- | -- | -- |
| Ethylbezene | 700 | -- | -- | 700 | 2,400 | 700 |
| Fluoranthene | -- | -- | -- | -- | 188 | -- |
| Naphthalene | -- | -- | -- | -- | -- | 20 |
| Pyrene | -- | -- | -- | -- | 0(0.0031) | -- |
| Toluene | 1,000 | -- | -- | -- | 15,000 | 1,000 |
| Xylenes | 10,000 | -- | -- | -- | -- | 10,000 |
| 2-Methylnaphthalene | -- | -- | -- | -- | -- | -- |
| Gross Alpha | 15 pCi/L | -- | -- | -- | -- | 15 pCi/L |
| Gross Beta | -- | -- | -- | -- | -- | -- |
| Radium 226,228 | 5 pCi/L | -- | -- | -- | -- | 5 pCi/L |

(1) Source: 40 CFR 141, updated with respect to 1990 EPA ARARs, where applicable.

(2) Source: Federal Register, Vol. 50, No. 145, July 29, 1985; Vol. 45, No. 231, November 28, 1980.

(3) Proposed MCLs, MCLGs, Federal Register, Vol. 54, No. 47, May 22, 1989, updated with respect to 1990 EPA ARARs, where applicable.

(4) For compounds identified as potential carcinogen by U.S. EPA, the criteria is 0. The value in parentheses is concentration which is associated with a $10^{-6}$ cancer risk.

(5) Iowa Criteria for action levels:
A-The HAL (lifetime Health Advisory Level) if one exists; if not
B-The NRL (Neglibible Risk Level, risk of 10E-06 over lifetime) if one exists; if not
C-The MCL (Maximum Contaminant Level) if one exists, if not
D-A concentration level established by the Iowa Department of Natural Resources, based on literature recommended guidelines of EPA and experts on a case-by-case basis.

characteristics that may affect the aesthetic qualities of drinking water (i.e., color, odor, and taste).

MCLs and MCLGs for contaminants of concern at the Installation are provided in Table 4.11. Proposed MCLs and proposed MCLGs are also identified. The concentrations provided are potential ARARs.

### Clean Water Act

The Clean Water Act (CWA) requires the establishment of guidelines and standards to control the direct or indirect discharge of pollutants to waters of the United States. The standards required by the CWA include water quality criteria for specific pollutants. EPA has developed two kinds of water quality criteria: one for the protection of human health and another for the protection of aquatic life. These criteria are non-enforceable guidelines used by the States to set water quality standards for surface water. These non-enforceable standards are potential ARARs when the state has not promulgated water quality standards for the specific pollutants and water bodies of concern.

### Iowa Action Levels

The Iowa Department of Natural Resources has established water quality standards based on U.S. EPA health advisory levels, negligible risk levels for carcinogens, and maximum contaminant levels. These values are presented in Table 4.11.

### Comparing ARARs to Maximum Levels at Site 1

In this section, concentrations of chemicals of concern are compared with appropriate criteria to provide a rough estimation as to whether the contaminant pose a risk. The method is intended as a preliminary screening tool rather than a detailed evaluation of risks posed by contaminants at the site.

In this section concentrations of chemicals of concern are compared with appropriate criteria to provide a rough estimation as to whether the contaminants pose a risk. The method is intended as a preliminary screening tool rather than a detailed evaluation of risks posed by contaminants at the site. For clarity, each of the two sites is evaluated separately. Where ARARs are not developed, other information may be needed to determine what is protective of human health and the environment. Other

criteria to be used for comparison purposes include health-based levels derived from toxicity data.

Current information on the health and environmental effects of various toxicants, including slope factors and RfDs were obtained from the Integrated Risk Information System (IRIS) [EPA, 1991] and the HEAST (Health Effects Assessment Summary Tables) from FY-1990. IRIS is a computerized library of current information that is updated on a continuous basis. It contains health risk assessment information on chemicals that have undergone a detailed review of toxicity data by work groups composed of EPA scientists from several agency program offices, and represents an EPA consensus. Information includes slope factors and RfDs for systemic toxicants. These values are used to calculate human health-based criteria according to EPA guidelines.

As previously described, human health-based criteria for carcinogens represent an upper bound estimate of the average daily dose of a carcinogenic substance that corresponds to a specified excess cancer risk for lifetime exposure. The criteria were calculated from slope factors (Table 4.12) in the following manner:

$$Ci = (R/q1^{*}) \times (W/I)$$

where:

$Ci$ = the criterion concentration for the constituent of interest;
$R$ = the specified risk level (e.g., 10-6);
$q1^{*}$ = the carcinogenic slope factor in (mg/kg/day)-1 developed by EPA;
$W$ = the assumed weight of the exposed individual; and
$I$ = the intake amount for a given time period.

Human health-based criteria for (i.e., noncarcinogenic) toxicants are an estimate of the daily exposure an individual (including sensitive individuals) can experience without appreciable risk of health effects during a lifetime, and are based on EPA-derived RfDs (Table 4.12).

## TABLE 4.12

## COMPARISON OF THE MAXIMUM CONCENTRATIONS OF CHEMICALS DETECTED IN SOIL SAMPLES WITH HEALTH CRITERIA FOR SOIL INGESTION

## SITE 1 - IOWA AIR NATIONAL GUARD

| Chemical of Concern | Maximum Release Concentration (mg/kg) | Type | Criterion Value (mg/kg) | Criteria Exceeded ? |
|---|---|---|---|---|
| Benzene | 5.6 | SF | 12 | No |
| Ethylbenzene | 44J | RfD | 35,000 | No |
| Toluene | 61J | RfD | 70,000 | No |
| Xylenes | 100J | RfD | 700,000 | No |
| Naphthalene | 2.7 | RfD | 1,400 | No |
| 2-Methylnaphthalene | 2.9 | NA | -- | -- |
| Dibenzofuran | 0.14 J | NA | -- | -- |
| Fluoranthene | 0.44 J | RfD | 14,000 | No |
| Pyrene | 0.58 | RfD | 10,500 | No |
| Benzo[a]anthracene | 0.29 J | NA | -- | -- |
| Chrysene | 0.34 J | NA | -- | -- |
| Benzo[b]fluoranthene | 0.71 | NA | -- | -- |

| | |
|---|---|
| NA | Not Available |
| SF | Slope Factor (carcinogens) |
| RfD | Reference dose (noncarcinogens) |

For soil ingestion, the assumed intake rate is 0.2 g/day for a 70 Kg construction worker. Human health-based criteria were calculated for the selected exposure routes, as shown in the following equation:

Ci = (RfD) x (W/I)

where

Ci = Criterion concentration for constituent of interest;
RfD = Reference Dose developed by EPA;
W = the assumed weight of the exposed individual; and
I = the intake amount for a given time period.

Where toxicants caused both carcinogenic and noncarcinogenic effects, the value based on carcinogenic effects was used for human health assessment.

The potential for current exposure at Site 1 is very low. Because affeced soils are below the surface and groundwater contamination has not migrated offsite, there are currently no completed pathways. If, however, contamination migrates to downgradient wells, pathway completion is possible. Table 4.13 compares the maximum concentrations found in groundwater at Site 1 with the appropriate criteria. The concentration of benzene exceeded the Iowa Action Level by almost 200 times.

The only other possible completed pathways would be if future construction workers excavate at Site 1. Table 4.12 compares the chemicals of concern in the soil with applicable criterion. None of the criterion were exceeded.

The probability of pathway completion is low at Site 1 for both current and future pathways.

There is a gap in the data regarding the number, distance and use of downgradient wells. This would affect potential pathways and exposure levels.

### Uncertainties in Risk Screening

In quantifying risks for a given receptor who is exposed to multiple chemicals by a number of different pathways, EPA generally assumes that the total risk incurred by the receptor is essentially a sum of the individual risks incurred by each chemical and pathway of exposure. This is reflected in the EPA methodology used to quantify both carcinogenic and noncarcinogenic risks. Thus, the potential for adverse effects in a

## TABLE 4.13

## COMPARISON OF MAXIMUM CHEMICAL CONCENTRATIONS WITH HEALTH CRITERIA FOR GROUNDWATER INGESTION SITE 1 - IOWA AIR NATIONAL GUARD

| Chemical of Concern | Maximum Release Concentration (μg/L) | Type | Criterion Value (μg/L) | Criteria Exceeded ? |
|---|---|---|---|---|
| Benzene | 180 | Iowa | 1 | Yes |
| Ethylbezene | 150 | Proposed MCL | 700 | No |
| Toluene | 5 | Proposed MCL | 2,000 | No |
| Xylenes | 360 | Iowa | 10,000 | No |
| 2,4-dimethylphenol | 10J | -- | -- | -- |

given receptor will increase with the number of chemicals detected at the site and the number of pathways by which the receptor could be exposed.

The preliminary risk assessment methodology employed here uses Health Criteria which were developed as though each chemical in question were present at the site by itself and as though exposure would occur through only one pathway (oral exposure to the medium of concern). Thus the risk screening process employed in this assessment considers only oral exposure pathways and does not apportion risks among the total number of chemicals detected at the site. Although in most cases, oral exposure will account for most contaminants, dermal and inhalation exposures are sometimes also of concern. If risks were apportioned among the total number of chemicals present and all possible pathways of exposure, Health Criteria values would be lower and site-specific.

Since the purpose of this evaluation procedure is to determine which sites may have potential problems, the procedure is adequate when the risk screening yields positive (yes) results as in the case of Site 1.

#### 4.3.4.3 Preliminary Ecological Evaluation

The purpose of this Preliminary Ecological Evaluation is to determine the potential effects of site contaminants on plant and animal species, and to determine if any data gaps exist which may need to be addressed in future investigations.

The Preliminary Human Health Evaluation is used as a basis for this Ecological Evaluation, including the sections discussing data evaluation, environmental fate and transport, and chemicals of concern.

##### 4.3.4.3.1 Selection of Chemicals of Concern

Selection of chemicals of concern were described in Subsection 4.3.4.2.1.

##### 4.3.4.3.2 Environmental Receptors

**Vegetation**

The Installation is located within the Missouri Alluvial Plain Physiographic Province. Vegetation in the area is characterized by treeless prairies, woodlands, and

row crops. Each of these types of vegetation are represented within the areal extent of this study.

Woodlands vegetation in this area include silver maple, aspen, cottonwood and elm. Treeless areas are generally vegetated with prairie grass. Row crops are grown in the area surrounding the Installation. Corn, oats, flax, soybeans and hay are crops commonly grown in this area of Iowa. Soil moisture levels in this region are sufficient to grow crops of this type without irrigation.

### Terrestrial and Aquatic Wildlife

In general, both the terrestrial and aquatic wildlife of grassland areas are limited in species diversity. This is due to the often homogeneous nature of food sources at the lower end of the food chain. For example, prairie grasses are often the dominant terrestrial plants and as such will limit the variety of species adapted for survival under those conditions.

Animals with specialized adaptations to grassland habitats will often occur in large numbers, occupy limited ecological niches and remain somewhat homogeneous taxonomically. For example, ground nesting birds such as the western meadowlark and red-winged blackbirds may be found to reside in the grasslands where arboreal growth is generally restricted due to overly moist soil conditions. Some grassland birds nest in the surface of the ground while others nest in weeds or shrubs. Such birds as the red-tailed hawk may occur in limited numbers which feed on small mammals such as mice and rabbits. Other common birds might include scavengers, such as crows and blackbirds.

Among small mammals, rodents are typical inhabitants of grassland areas. Such rodents in this area might include woodchuck, deer mice, squirrels and the cottontail rabbit. Other small mammals might include herbivores such as the prairie vole and red squirrel as well as second level carnivores such as the red fox and racoon, among others.

Terrestrial reptiles expected to reside in these grasslands might include the king snake, black snake and garter snake. Semi-aquatic reptiles residing in small ponds or streams with muddy bottoms might also include the common snapping turtle.

Amphibians common to this area of grassy swayles, intermittent tree cover and heavily vegetated ponds might include the Great Plains toad, tree frogs and tiger salamander, among others.

Insects expected to occur in great numbers here might include various grasshoppers (Orthopteran Order). Aquatic insects and/or insect larvae found in ephemeral streams or temporary ponds of this area might include mosquitoes, true flies such as chironomidl midges, caddisflies, water strider, cicadas, mayflies, beetles, craneflies, and honeybees.

Fish species expected to occur in the area's ephemeral streams might include catfish and carp.

#### 4.3.4.3.3 Ecological Exposure Pathways

As stated previously, the Installation is located within the Missouri Alluvial Plain of Iowa. Vegetation on the site is characterized by maple, ash, cottonwood and aspen and woodland, prairie grasslands. The area is currently influenced predominantly by agricultural and rural uses. Wildlife includes a variety of species including ground nesting birds, hawks, small mammals, snakes, turtles, frogs and insects. It is not known whether endangered species occur on the Installation.

Receptor organisms were identified by biological resource group based on those organisms likely to be present at the base. Receptor organisms were categorized as follows: wildlife, aquatic life, and vegetation. Ecological receptors may be exposed to chemical contaminants through direct or indirect pathways. Direct pathways would include direct contact with or ingestion of contaminated media such as soil, sediment, or water. Indirect pathways include those in which an animal consumes other previously-contaminated organisms. If exposure pathways between contaminated media and receptor organisms are not complete, contaminants do not constitute an environmental risk.

Exposure media and routes may differ between various organisms due to their physiological and behavioral differences. For example, fish-eating birds may be exposed to contaminants by consuming fish that have bioaccumulated contaminants from surface water and sediments, whereas seed-eating birds may be exposed to contaminants from direct contact with soils, through incidental ingestion of soil while foraging, or from

seeds that have assimilated contaminants through plant uptake from the soil. Environmental Pathways are summarized in Table 4.14. The following sections discuss in more detail the exposure pathways for each type of receptor.

### Soils

Terrestrial animals at the site may be directly and indirectly exposed to contaminants in the soil. Direct dermal contact with subsurface contaminated soil and incidental ingestion of soil could occur among burrowing animals. In general, information for quantifying and evaluating the toxicity of dermal exposures to wildlife species is limited.

Indirect exposure to soil contaminants may occur through ingestion of soil-dwelling invertebrates, (e.g., earthworms) or grasses and other plants which may bioaccumulate contaminants. As with other exposure pathways, the importance of this pathway varies from species to species because of behavioral differences. For example, populations of animals such as field mice, which are ground-dwelling animals and fastidious groomers, may be more greatly affected by contaminated soils than other species which contact soil less often.

Plants may be directly exposed to contaminants in soil via uptake through their roots. Chemicals may accumulate in plant tissues depending on the species. Because chemical uptake is known to vary between plant species and tissues, evaluating the potential impacts to plants is often difficult. However, plant phytotoxic criteria for agriculturally important species are relatively well documented.

### Groundwater

Groundwater contaminants may constitute a risk to environmental receptors when utilized by plants, discharged by springs or wells to where animals may drink, and when surface waters are contaminated by groundwater discharges. Pathways may be direct or indirect, and are most common where groundwater depths are shallow.

Plants with roots extending to the water table may be affected or may concentrate contaminants found in groundwater. This may cause direct phytotoxic effects to result. Similarly, the ingestion of contaminated drinking water may affect small and large mammals, birds, and all other organisms ingesting water derived from wells or springs.

## TABLE 4.14

## MATRIX OF POTENTIAL ECOLOGICAL EXPOSURE PATHWAYS
## SITE 1 - IOWA AIR NATIONAL GUARD

| Transport Medium | Release Source or Mechanism | Primary Exposure Point | Potential Receptors | Primary Exposure Route | Probability of Pathway Completion |
|---|---|---|---|---|---|
| Groundwater | Affected soils, groundwater | Downgradient wells used for drinking/ irrigation | Surrounding plants and animals. | Ingestion, Inhalation, Dermal | Low: affected groundwater is limited to the immediate vicinity of Site 1 and penetration of roots and burrowing animals to that depth is unlikely. |
| Soils | Affected soils, groundwater/site leaching. | Site 1 | Surrounding plants and animals | Ingestion, Inhalation, dermal | Moderate: Subsurface soil at Site 1 may be encountered by burrowing animals and plant roots. |

As shown in Table 4.14, the potentially complete pathways considered for these sites are as follows:

- Contact of animals and plants with contaminated soils.
- Contact of plants, animals and aquatic life with contaminated groundwater.

#### 4.3.4.3.4 Risk Screening

Important pathways for ecological exposure at Site 1 have been presented in this evaluation. However, no criteria are available for comparison. The results of the human health evaluation revealed chemical levels in groundwater exceeding human health based criteria. This indicates a potential for adverse health effects to wildlife and vegetation exposed to contaminated soil or groundwater.

#### 4.3.4.3.5 Uncertainty

Uncertainties arise from the lack of criteria and also the lack of information on sensitive biotic communities and species that may be present in the area of the Installation.

### 4.3.5 Conclusions and Recommendations

- The soil and groundwater at SITE 1 are contaminated with volatile petroleum hydrocarbons, the components of JP-4 fuel.
- The preliminary risk assessments shows that presently there are no completed exposure pathways. Future pathway may be completed depending on the land use.
- The extent of contamination has been generally defined, however, further investigation is recommended along with simultaneous and immediate remedial activities.

## 4.4 SITE 2 - POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

### 4.4.1 Site Description

This area, located within the ammunition storage area west of the Installation, was reportedly used by the Air Force for the disposal of low-level radioactive wastes, such as radio tubes. The area is approximately ten feet square and enclosed by a dilapidated wire fence. Three padlocked metal cylinders protrude from the ground

within this area. At the time of the SI, there were no signs of contamination and a Geiger counter detected no radioactivity in the vicinity of the fenced area.

It is assumed that only small volumes of low-level radioactive waste were disposed of in this ten by ten foot area. The waste reportedly consisted of radio tubes which were placed in metallic containers. Because it is not precisely known if only radio tubes were disposed of, the radiation survey and the environmental samples included monitoring for all types of radiation. One other assumption in the planning of the subsurface program was that potential radiation which may be picked up by cursory surface monitoring may not necessarily be representative of that occurring at depth either in intensity or in type. Therefore for health and safety purposes especially during the drilling/sampling program, the monitoring equipment was responsive to all types of radiation at low levels.

### 4.4.2 Field Activities

A radiological survey was conducted at the potential low-level radioactive waste disposal area (Site 2). The purpose of this survey was to determine surface radioactivity levels. The survey was conducted using an Eberline Geiger Mueller survey meter, Model E-120. The instrument was calibrated at the factory and checked in the field with a vendor provided radioactive source prior to use.

The radiological survey consisted of recording the background radiation level approximately 200 feet from site and then obtaining general area readings three feet above the ground at 22 locations over the site. Six locations over and around the exposed portions of the storage containers were also checked with contact readings (Table 4.15). Survey locations were recorded in the field log book.

A surface magnetometer survey was also conducted. In this area, three metal containers are partially exposed. A smaller grid was set up at the Site 2 background well location. This survey was designed to identify the presence of other objects which may have been buried or to otherwise identify the approximate limits of the disposal area.

The magnetometer survey consisted of station-to-station measurements using a grid system. The stations were set five feet apart using a measuring wheel and a Brunton compass. The measurements were obtained using a Geometrics G826 Magnetometer which indicates the total magnetic field intensity at the site in gammas. The field measurements and grid locations were recorded in the field notebook.

## TABLE 4.15

## RADIOLOGICAL SURVEY DATA

## IANG - SERGEANT BLUFF, IOWA

| Location | Height of Instrument | |
|---|---|---|
| | 3 feet above grade (MR/HR) | Contact at grade (MR/HR) |
| 1 | 0.02 | -- |
| 2 | 0.02 | -- |
| 3 | 0.02 | -- |
| 4 | 0.02 | -- |
| 5 | 0.02 | -- |
| 6 | 0.02 | -- |
| 7 | 0.02 | -- |
| 8 | 0.02 | -- |
| 9 | 0.02 | -- |
| 10 | 0.02 | -- |
| 11 | 0.02 | -- |
| 12 | 0.02 | -- |
| 13 | 0.02 | -- |
| 14 | 0.02 | -- |
| 15 | 0.02 | -- |
| 16 | 0.02 | -- |
| 17 | 0.02 | 0.02 |
| 18 | 0.02 | 0.02 |
| 19 | 0.02 | 0.02 |
| 20 | 0.02 | 0.02 |
| 21 | 0.02 | 0.02 |
| 22 | 0.02 | 0.02 |

Soil boring samples were collected from 28 to 30 July 1990. These samples were collected in accordance with previously stated procedure (sub-section 3.2.4). All samples were screened in the field for radiation using the Geiger Mueller. Three samples from each boring were selected for laboratory analysis based on stratigraphic interval. The samples were analyzed for gross alpha, gross beta, radium 226 and radium 228.

Temporary monitoring wells at Site 2 were installed in the five soil borings. Immediately after the last sample was taken, the well was installed through the hollow-stem augers then the augers were removed as the sand pack, bentonite pellets and bentonite slurry were installed. The wells were installed by this method for ease of removal after one groundwater sampling event.

Temporary wells IANG-2-TW-1,-2,-3 and -4 were installed radially around the site within thirty feet of the wire fence. IANG-2-TW-5 was installed approximately 155 feet north of the fenced-off casings as a Site 2 background well.

These wells were developed on 13 August 1990. Development was conducted using a 1.5 inch I.D. by 3 foot long Teflon bailer. 45 gallons of water were bailed from each well and contained in a 55 gallon drum.

Groundwater samples were collected on 14 August 1990 and submitted for laboratory analyses. A duplicate from well IANG-2-TW-5 was also submitted for laboratory analyses. The wells were purged using a 1.5-inch by 3-foot Teflon bailer. Purging was conducted as described in sub-section 3.2.6. The purge water was added to the development water contained in a 55 gallon drum. These samples were analyzed for gross alpha, gross beta, radium 226 and radium 228. In-situ hydraulic conductivity tests were run on the wells on 21 August 1990.

Two soil samples were also collected approximately one mile east of Site 2, at the site of an underground storage tank (UST) assessment. The range of concentrations detected were 1.2 pCi/g to 1.6 pCi/g for gross alpha and 1.0 pCi/g to 1.3 pCi/g for gross beta.

### 4.4.3 Results of Field Program

#### 4.4.3.1 Radiological Survey Results

The area radiological survey results indicated readings of background radiation levels of 0.02 MR/HR (millirems per hour). The contact readings indicated background radiation levels of 50 CPM (counts per minute).

#### 4.4.3.2 Magnetometer Survey Results

The magnetic data obtained during the magnetometer survey was reviewed and used to generate a contour map (Figure 4.6). The magnetic contour map shows a high and low anomaly directly adjacent to the three metal casings. The data indicates a detection of the ferromagnetic material (metal) used in the casings. No buried metallic objects were detected outside the barbed wire fence. The magnetic data is found in the Field Notes in Appendix B.

#### 4.4.3.3 Hydrogeologic Results

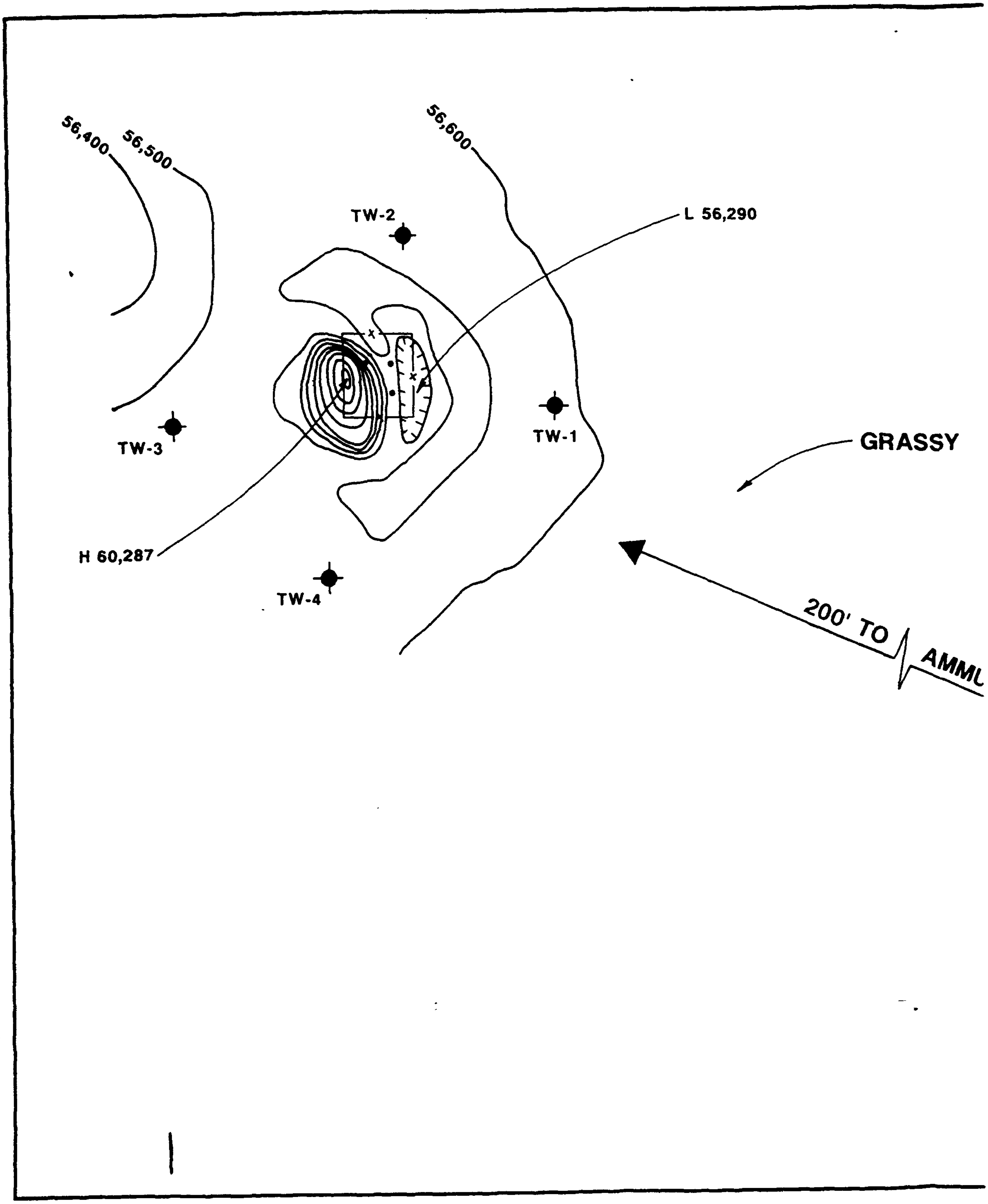
The borings for monitor wells IANG-2-TW-1,-2,-3,-4, and TW-5 penetrated brown and gray silt and silty clay overlying brown and gray silty sand (Appendix E). The wells were installed to approximately 30 feet. The 10 foot well screen spanned the unsaturated and saturated zone interface in a fine-grained silty sand. Water was detected during drilling at 22.5' to 24.5'.

Water levels were measured in all the wells on 21 August 1990. The water levels ranged from 24 to 2.6 feet below grade. The general groundwater flow direction is believed to be to the west, toward the Missouri River. The placement of the temporary wells permitted sample collection from both upgradient and downgradient.

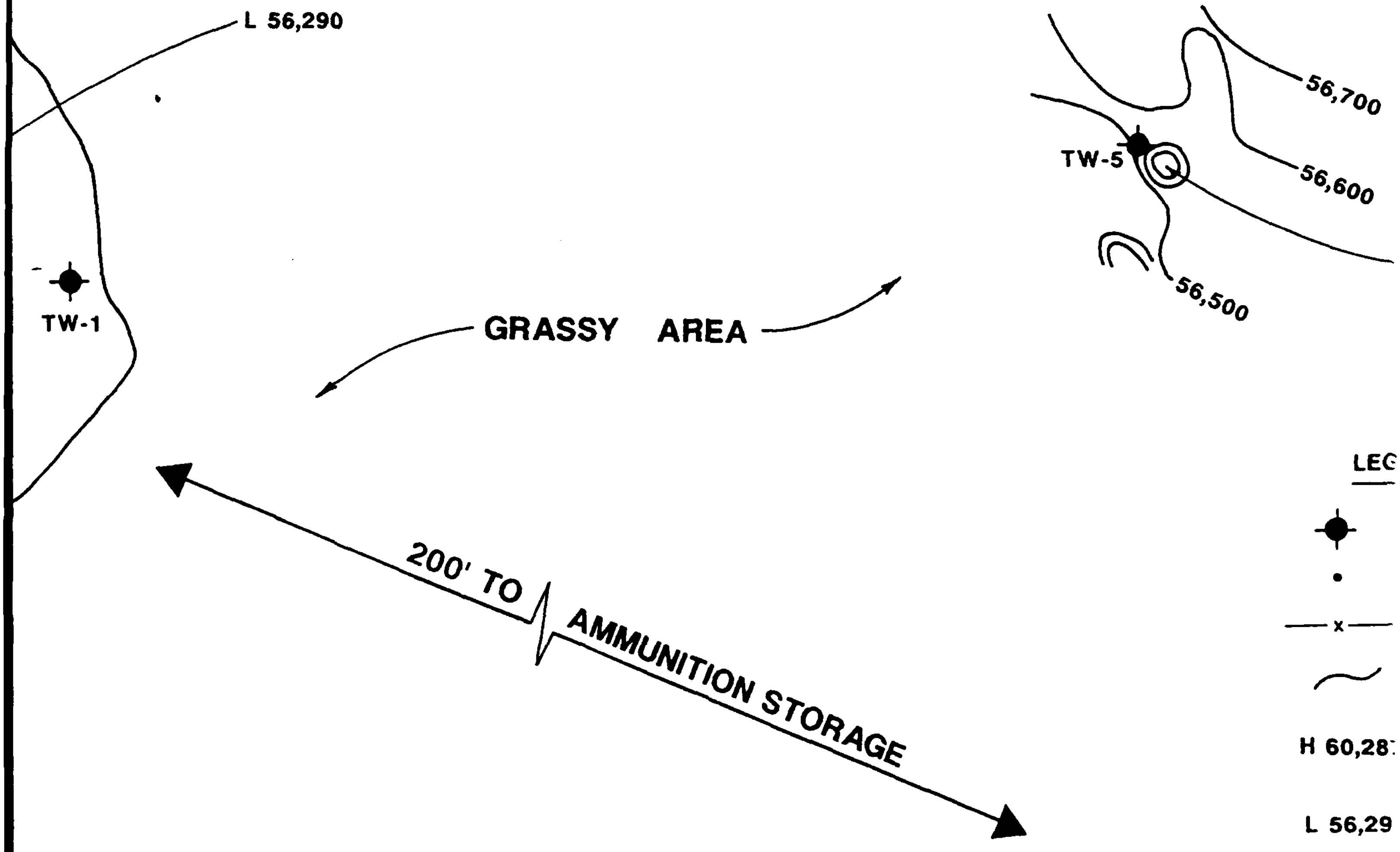
In-situ hydraulic conductivity testing in the temporary wells at Site 2 revealed values ranging from 4.1x10-3 cm/sec (11.66 ft/day) to 1.02x10-2 cm/sec (28.99 ft/day). Test work sheets are presented in Appendix F.

#### 4.4.3.4 Chemical Analysis Results

Soil samples were collected at Site 2 during the drilling of the temporary wells (Table 4.16). All the soil samples submitted to the laboratory were analyzed for gross alpha, gross beta, radium 226 and radium 228. The analytical results are summarized in Table 4.17.



56,400
56,500
56,600
TW-2
L 56,290
TW-3
TW-1
GRASSY
H 60,287
TW-4
200' TO
AMMU



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SITE 2:

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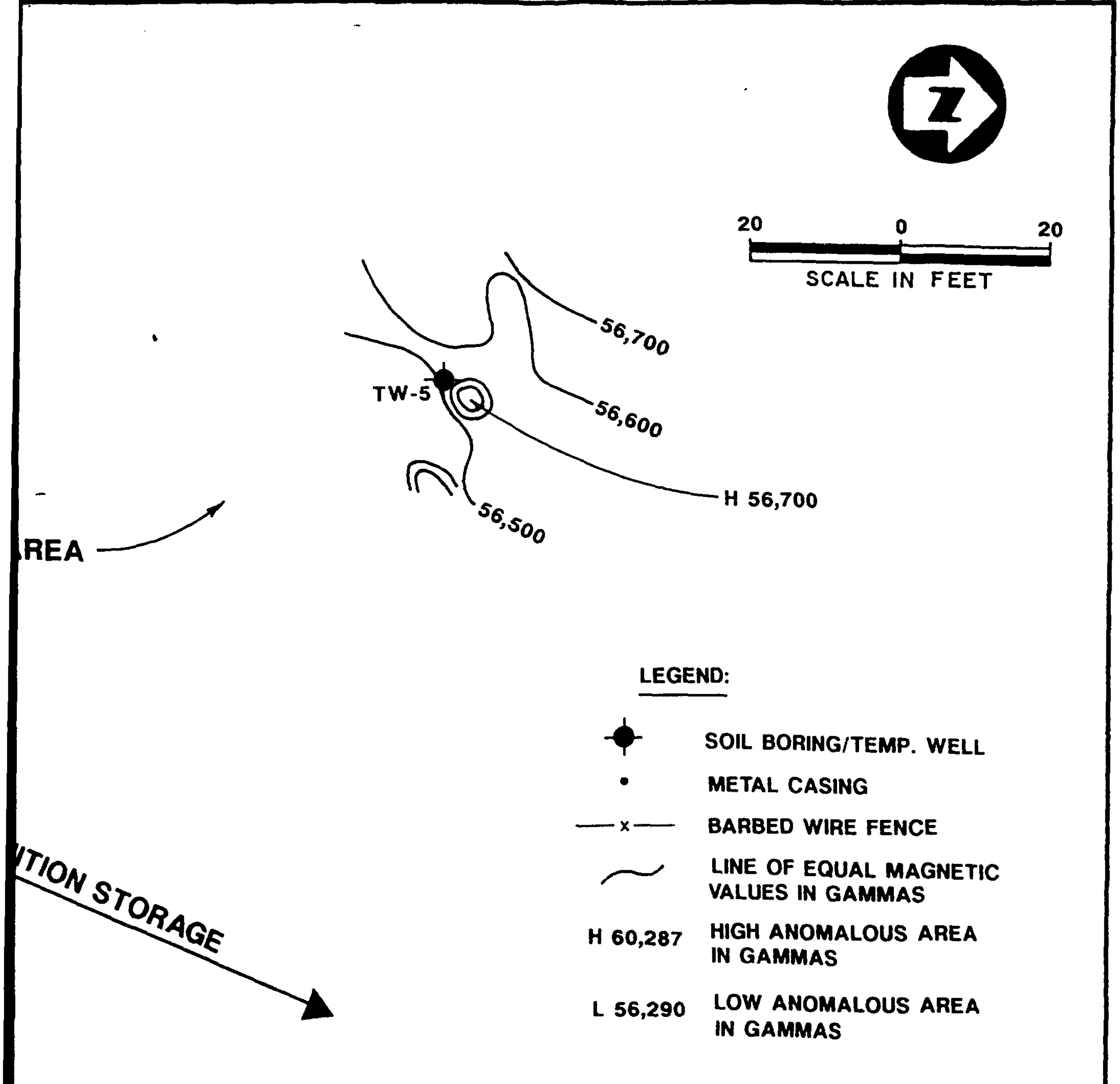
FIGURE 4.6



## MAGNETIC SURVEY MAP

SITE 2: POTENTIAL LOW-LEVEL
RADIOACTIVE WASTE DISPOSAL AREA
IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

3

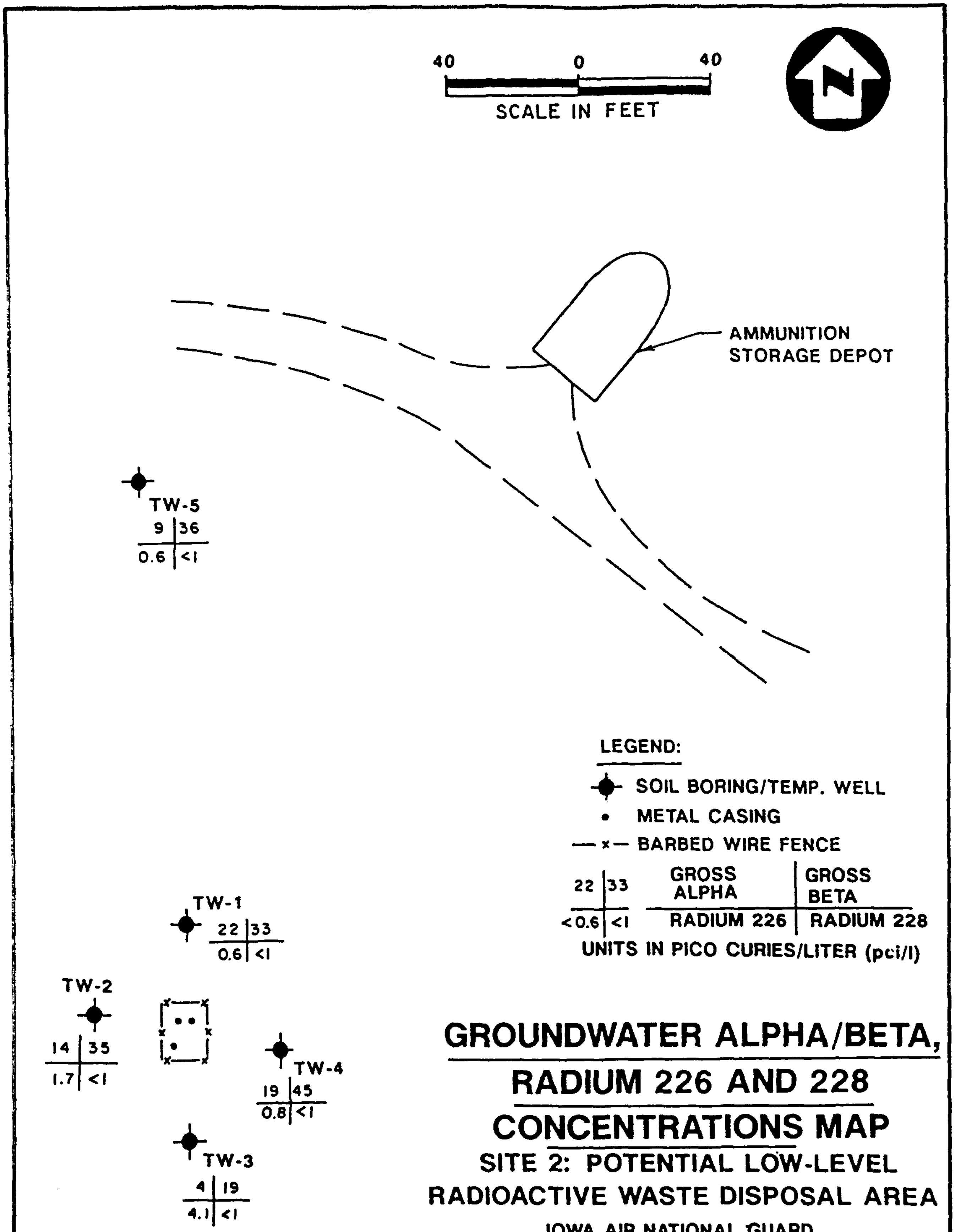
The soil samples collected during the drilling of IANG-2-TW-1,-2,-3,-4 and -5 contained the following ranges of concentrations in pico curies per gram (pCi/g): gross alpha (0.7 to 3.3), gross beta (1.3 to 5.3), radium 226 (0.47 to 1.6) and radium 228 (<0.2 to 2.4) (Figure 4.8). Two background, upgradient soil samples were collected from Site 1 at IANG-1-SB-7/MW-6. The range of concentrations was: gross alpha (<0.5 to 35.6 pCi/g), gross beta (<0.8 to 7.8 pCi/g), radium 226 (<0.3 to 0.51 pCi/g), and radium 228 (<0.5 pCi/g).

Two soil samples were also collected approximately one mile east of Site 2, at the site of an underground storage tank (UST) assessment (UST MW-1). The range of concentrations was: gross alpha (1.2 to 1.6 pCi/g) and gross beta (1.0 to 1.3 pCi/g).

The groundwater samples collected from the wells at Site 2 were submitted for laboratory analysis of gross alpha, gross beta, radium 226 and radium 228. The results revealed a range of the following concentrations in pico curies per liter (pCi/l): gross alpha (4 to 22), gross beta (19 to 45), radium 226 (0.6 to 4.1), radium 228 (<1) (Figure 4.7). Monitor well MW-6 at Site 1 was sampled as a background upgradient well. The results revealed concentrations of 21 pCi/l gross alpha, 32 pCi/l gross beta, 17.0 pCi/l radium 226 and <1 pCi/l radium 228. A groundwater sample was also collected from UST MW-1. Results from this well showed a gross alpha concentrations of 25 pCi/l and a gross alpha beta concentration of 41 pCi/l. Table 4.18 summarizes the analytical results.

The United States Environmental Protection Agency (U.S. EPA) has established MCLs for gross alpha (15 pCi/l including radium 226, but excluding radon and uranium) and combined radium 226 and radium 228 (5 pCi/l). Samples from TW-1 and TW-4 at Site 2 revealed gross alpha concentrations of 22 pCi/l and 19 pCi/l, respectively, both of which are above the MCL for gross alpha (15 pCi/l). However, the laboratory analysis for gross alpha includes gross alpha, radium 226 and uranium, whereas, the MCL for gross alpha includes gross alpha and radium 226, excluding uranium.

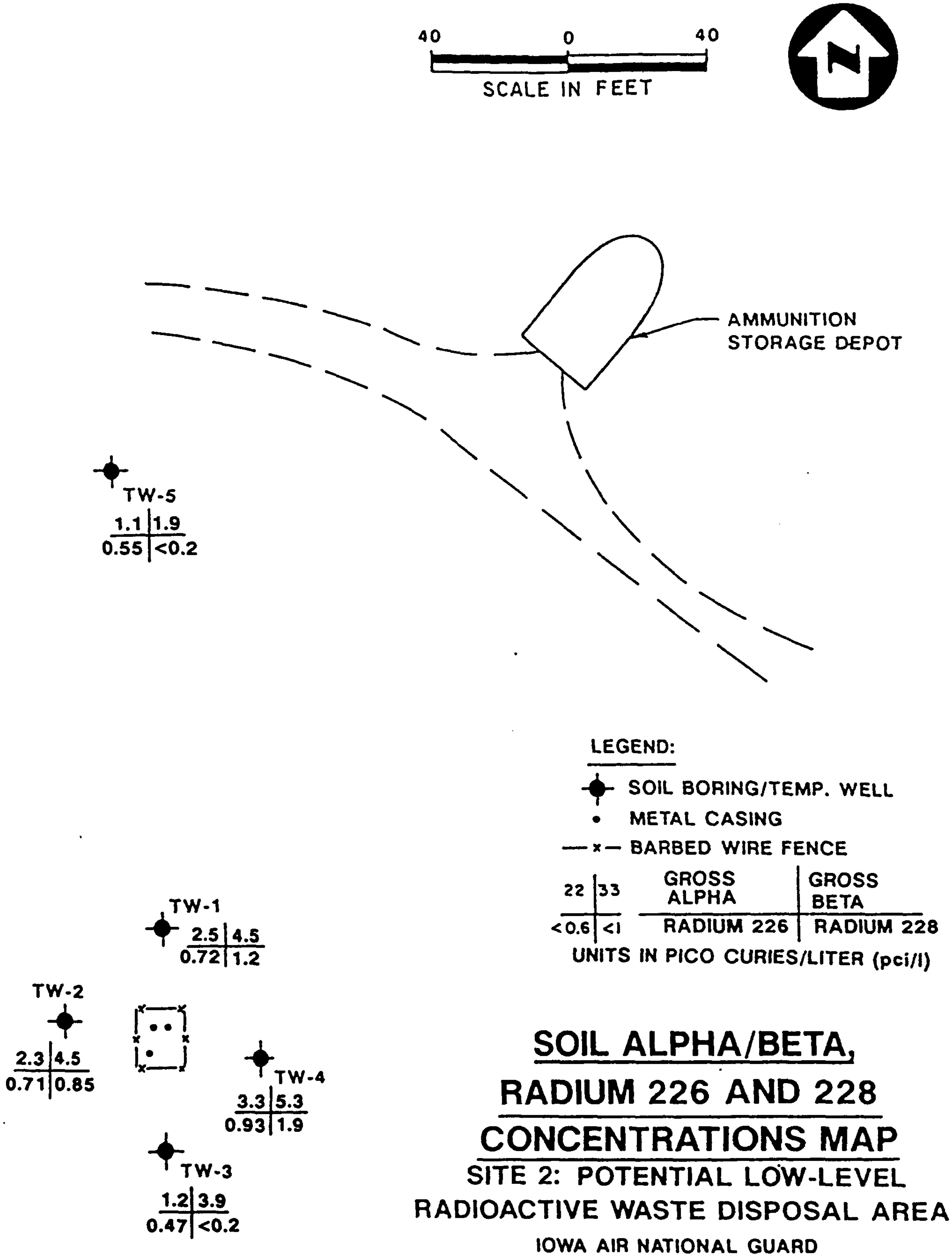
The groundwater samples from Site 1 (MW-6) revealed concentrations of gross alpha and radium 226 and radium 228 above the MCL. However, these concentrations fall within typical levels and there is no evidence known of radioactive materials being disposed of in the area of Site 1 (Kastanzo, 1990; Mueller, 1990; Nazaroff, 1988). Gross alpha was detected at 21 pCi/l and radium 226 was detected at 17 pCi/l, radium 228 was



# GROUNDWATER ALPHA/BETA, RADIUM 226 AND 228 CONCENTRATIONS MAP

## SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

IOWA AIR NATIONAL GUARD
185 th TACTICAL FIGHTER GROUP
SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA



# SOIL ALPHA/BETA, RADIUM 226 AND 228 CONCENTRATIONS MAP

## SITE 2: POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

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SIOUX GATEWAY AIRPORT
SERGEANT BLUFF, IOWA

## TABLE 4.16

## SITE 2 - SOIL AND WATER SAMPLES SUBMITTED FOR LABORATORY ANALYSIS

## IANG - SERGEANT BLUFF, IOWA

| Location | Soil (Sample Depth) | Analysis |
|---|---|---|
| TW-1 | (2'-4',8'-9',20'-22') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |
| TW-2 | (2'-4',8'-9',24'-22') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |
| TW-3 | (2'-4',8'-9',20'-22') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |
| TW-4 | (2'-4',8'-10',20'-22') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |
| TW-5 | (2'-4',8'-10',20'-22') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |
| UST (MW-1) | (15'-17',25'-27') | Gross Alpha, Gross Beta, Radium 226, Radium 228 |

# TABLE 4.17
## DETECTED COMPOUNDS IN SOIL SAMPLES
## SITE 2 POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA
## IANG, SERGEANT BLUFF, IOWA

| Sample ID: | IANG-2<br>SB-1-S1 | IANG-2<br>SB-1-S2 | IANG-2<br>SB-1-S3 | IANG-2<br>SB-2-S1 | IANG-2<br>SB-2-S2 | IANG-2<br>SB-2-S3 | IANG-2<br>SB-3-S1 | MCL (1) |
|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 27-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 29-Jul-90 | |
| **Radiological Parameters (pCi/g)** | | | | | | | | |
| Gross Alpha | 0.9+/-0.6 | 2.5+/-0.7 | 1.5+/-0.7 | 1.8+/-0.8 | 2.3+/-0.7 | 1.2+/-0.6 | 2.0+/-0.8 | 15 (2) |
| Gross Beta | 3.3+/-0.9 | 4.5+/-0.8 | 3.4+/-0.9 | 2.6+/-0.8 | 4.5+/-0.9 | 2.5+/-0.8 | 2.5+/-0.8 | ---- |
| Radium-226 | 0.74+/-0.23 | 0.72+/-0.26 | 1.5+/-0.2 | 0.82+/-0.20 | 0.71+/-0.22 | 1.3+/-0.1 | 1.6+/-0.2 | 5 (3) |
| Radium-228 | 0.2 U | 1.2+/-0.2 | 0.2 U | 1.1+/-0.2 | 0.85+/-0.30 | 0.2 U | 0.2 U | |

Footnotes:

U--the compound was analyzed for, but not detected.
(1) Source: 40 CFR 141, updated with respect to 1990 EPA ARARs, where applicable
(2) Includes radium 226 and excludes radon and uranium
(3) Includes radium 226 and radium 228

| Sample ID: | IANG-2<br>SB-3-S2 | IANG-2<br>SB-3-S3 | IANG-2<br>SB-3-S4 | IANG-2<br>SB-4-S1 | IANG-2<br>SB-4-S2 | IANG-2<br>SB-4-S3 | IANG-2<br>SB-5-S1 | IANG-2<br>SB-5-S2 |
|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 29-JUL-90 | 29-JUL-90 | 29-JUL-90 | 30-JUL-90 | 30-JUL-90 | 30-JUL-90 | 30-JUL-90 | 30-JUL-90 |
| **Radiological Parameters (pCi/g)** | | | | | | | | |
| Gross Alpha | 1.2+/-0.6 | 1.0+/-0.6 | 1.3+/-0.6 | 1.7+/-0.7 | 3.3+/-0.8 | 1.5+/-0.6 | 0.7+/-0.5 | 1.1+/-0.6 |
| Gross Beta | 3.9+/-0.8 | 2.0+/-0.8 | 1.9+/-0.8 | 3.8+/-1.0 | 5.3+/-1.0 | 1.3+/-0.8 | 1.8+/-0.8 | 1.9+/-1.0 |
| Radium-226 | 0.47+/-0.18 | 1.0+/-0.3 | 1.4+/-0.2 | 1.4+/-0.2 | 0.93+/-0.16 | 0.78+/-0.15 | 1.6+/-0.2 | 0.55+/-0.28 |
| Radium-228 | 0.2 U | 0.2 U | 0.2 U | 1.6+/-0.3 | 1.9+/-0.8 | 1.8+/-0.9 | 2.4+/-1.1 | 0.2 |

## TABLE 4.17 continued
## DETECTED COMPOUNDS IN SOIL SAMPLES
## SITE 2 POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA
## IANG, SERGEANT BLUFF, IOWA

| Sample ID: | IANG-2<br>SB-5-S3 | IANG-2<br>SB-5-S4 | IANG-2<br>BENTONITE | IANG-2<br>SB-7<br>MW-6-BR1 | IANG-2<br>SB-7<br>MW-6-BR2 | UST SITE<br>MW-1<br>BACKGROUND | UST SITE<br>MW-1<br>BACKGROUND | MCL (1) |
|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 30-JUL-90 | 30-JUL-90 | 30-JUL-90 | 10-AUG-90 | 10-AUG-90 | 12-DEC-90 | 12-DEC-90 | |
| Radiological Parameters (pCi/g) | | | | | | | | |
| Gross Alpha | 1.0+/-0.6 | 0.9+/-0.6 | 11.4+/-1.4 | 35.6+/-2.4 | 0.5U | 1.2+/-0.6 | 1.6+/-0.7 | 15 (2) |
| Gross Beta | 2.3+/-1.0 | 0.9 U | 8.8+/-1.3 | 7.8+/-1.3 | 0.8U | 1.3+/-1.0 | 1.0+/-0.5 | ---- |
| Radium-226 | 0.85+/-0.25 | 0.36+/-0.10 | 4.9+/-0.3 | 0.3U | 0.51+/-0.34 | | | 5 (3) |
| Radium-228 | 0.2 U | 2.4+/-0.5 | 8.9+/-1.4 | 0.5U | 0.5U | | | |

Footnotes:

U--the compound was analyzed for, but not detected.
(1) Source: 40 CFR 141, updated with respect to 1990 EPA ARARs, where applicable
(2) Includes radium 226 and excludes radon and uranium
(3) Includes radium 226 and radium 228

### TABLE 4.18
### DETECTED COMPOUNDS IN WATER SAMPLES
### SITE 2 POTENTIAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA
### IANG, SERGEANT BLUFF, IOWA

| Sample ID: | IANG-2 TW-1 | IANG-2 TW-2 | IANG-2 TW-3 | IANG-2 TW-4 | IANG-2 TW-5 | IANG-1 MW-6 BACKGROUND | UST SITE MW-1 BACKGROUND | MCL (1) |
|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | | 12-Dec-90 | |
| **Radiological Parameters (pCi/l)** | | | | | | | | |
| Gross Alpha | 22+/-10 | 14+/-9 | 4+/-3 | 19+/-9 | 9+/-8 | 21+/-7 | 25+/-4 | 15 (2) |
| Gross Beta | 33+/-12 | 35+/-12 | 19+/-6 | 45+/-12 | 36+/-12 | 32+/-7 | 41+/-5 | -------- |
| Radium-226 | 0.6 U | 1.7+/-0.6 | 4.1+/-1 | 0.8+/-0.5 | 0.6 U | 17.0+/-7.8 | ---- | 5 (3) |
| Radium-228 | 1 U | 1 U | 1 U | 1 U | 1 U | 1U | ---- | |

Footnotes:

U--the compound was analyzed for, but not detected.
(1) SOURCE: 40 CRF 141, UPDATED WITH RESPECT TO 1990 EPA ARAR'S, WHERE APPLICABLE
(2) INCLUDES RADIUM 226 AND EXCLUDES RADON AND URANIUM
(3) INCLUDES RADIUM 226 AND RADIUM 228

not detected above the detection limit of 1 pCi/l. Groundwater from UST MW-1 also exceeded the MCL for gross alpha. Laboratory analyses showed the sample to have 25 pCi/l.

The data indicate the background concentrations of gross alpha, radium 226 and radium 228 at Site 1 and Site 2 exceed the MCL. This could be due to uranium concentrations included in the laboratory analysis for gross alpha and/or the percentage of naturally occurring radionuclides in the sediments in this particular geographic area.

### 4.4.4 Exposure Assessment

The data results are presented in Tables 4.17 and 4.18 in Section 4 of this report. Site 2 does not show evidence of radioactivity above background levels. Because it is likely that these levels are naturally occurring, no further risk evaluation will be done for this site.

### 4.4.5 Conclusions and Recommendations

The results of analyses for gross radioactivity and radium performed on soil and water samples collected from Site 2 suggest that the levels are within the range of naturally occurring concentrations. None of the soil samples displayed concentrations exceeding the MCL; water samples did, however, contain concentrations which exceeded the MCL, but which were lower than background levels.

A soil sample collected at Site 2 as a background value did exceed the MCL. This value may be considered as an anomaly because another sample collected from directly beneath yielded a value below the MCL as did all other soil samples analyzed from the site.

There is no indication that the concentrations of gross alpha detected in the groundwater at Site 2 are the result of activities from the Iowa Air National Guard Installation. A preliminary risk evaluation was not performed at Site 2 because concentrations of radionuclides did not exceed levels found to be typical for the Installation. The entire Installation seems to have a naturally occurring concentration of radionuclides which probably extend off Base.

No further site activities are recommended for Site 2.

## SECTION 5

## LABORATORY QUALITY CONTROL REPORT

This Section presents a summary and review of quality assurance and quality control results for the laboratory analysis of water and soil collected from Site 1 and Site 2 at IANGB in Sergeant Bluff, Iowa. This investigation was part of the Site Investigation during the period of July to August, 1990.

Analysis of soil and water samples for volatile organics (Method 8020), semi-volatile organics (CLP) and TPH (418.1) was performed by Engineering-Science Berkeley Laboratory (ESBL). Radioactivity parameters on soil and water samples were determined by Controls for Environmental Pollution, Inc. (CEP).

The results from ESBL are divided into five data packages. Each data package is assigned a work order number and includes all the required quality control documentation. Each package was validated by reviewing holding times, GC/MS tuning, initial and continuing calibration, blank/spike control samples, surrogate results, method blanks, matrix spike/spike duplicates and field quality control sample results. If the criteria were not met in any of these categories, action was taken as specified by the HAZWRAP document DOE/HWP-65/RI. Specific problems will be discussed in this section along with the action that was taken. Validation notes are included in Appendix I. Laboratory deliverables will be submitted under separate cover.

The analytical results of the environmental and quality control (QC) samples were evaluated to assess the representativeness, precision and accuracy, comparability and completeness of the data.

Representativeness was evaluated from the analytical results of the trip blanks, field blanks, rinseate blanks, method blanks and field duplicate samples. Analytical results of the blanks, except for the method blanks, are summarized in Appendix H. Comparison of the analytical results from duplicate samples are also summarized in Appendix H. The method blank summaries are included with the other data deliverables.

Precision and accuracy were evaluated by reviewing the laboratory matrix spike sample (MS), matrix spike duplicate sample (MSD) and the surrogate spike sample.

This information along with the Case Narratives which discuss specific QC problems, is included with the data deliverables.

Comparability qualitatively expresses the confidence with which one data set can be compared with another. Analytical methods were used for this investigation which are documented standard methods. Any investigation in the future can use these same methods to compare the results with this site investigation.

The completeness of the results was determined by the number of valid analyses compared to invalid analyses. This is determined from the results of the data validation procedure.

## 5.1 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data represents the characteristics of a population. Therefore, the level of representativeness of the data is often determined by the methodology of the field sampling program. The methods used for the sampling of the soil and groundwater at IANG are described in Section 3 of the text. The sampling protocol was followed to insure a high level of sample representativeness.

### 5.1.1 Field Blanks

A field blank is a sample of the deionized organic-free water used for decontamination. It is placed directly from the source bottle into an appropriate sample container. Two field blanks were associated with the sampling at Site 1 and four blanks at Site 2. The field blanks were analyzed for aromatic hydrocarbons, semi-volatile organics and TPH at Site 1 and radioactivity parameters at Site 2. No compounds were detected in the field blanks from Site 1. Two of the field blanks at Site 2 were the tap water used for decontamination. Gross Beta was detected in one of the tap waters at 7+/-3 pCi/L. All four radioactivity parameters were non-detected in the dionized water blank, except for radium-228 in IANG-2-FB-2 (DIUF) at very close to the detection limit. Since this water is always used as a final rinse, the gross beta found in the tap water should not present a problem and the radium-228 is very low. The field blank data is presented in Appendix H.

### 5.1.2 Trip Blanks

A trip blank consisted of deionized organic-free water in 40 ml vials filled by the laboratory for purposes of traveling with a cooler of samples back to the lab. The trip blanks were only analyzed for aromatic hydrocarbons. None of the six trip blanks showed any aromatics above detection limits. The trip blank data is presented in Appendix H.

### 5.1.3 Rinseate Blanks

Rinseate blanks consisted of deionized organic-free water poured through the decontaminated bailer or split-spoon into sample bottles. The rinseate blank data is presented in Appendix H. The rinseate blanks were analyzed for aromatic hydrocarbons, semi-volatile organics and TPH at Site 1 and radioactivity parameters at Site 2. No compounds were detected.

### 5.1.4 Method Blanks

Method blanks are aliquots of analyte-free water analyzed with a sample batch to identify contaminants introduced by the preparation or analysis procedure. Method Blank Summary sheets are included with the data deliverables under separate cover. The Method Blank Summary Sheets were reviewed for each batch of analyses. No analytes were detected in any of the method blanks, except for one. In Work Order 2136, di-ni-butyl-phthalate was found in method blank MSBNA900822 at 160 J g/kg. In an associated sample, IANG-1-SB6/MW5-S1 the same phthalate was found at 180 J g/kg. Since this is a common lab contaminant and it was found within ten times the blank concentration, the sample concentration was flagged as non-detected (U).

### 5.1.5 Duplicate Samples

The analytical results of the soil and water duplicate samples are sumarized in Appendix H. Two soil duplicate sets from Site 1 were analyzed for aromatic volatile organics, semivolatile organics and TPH. For each set, the concentration of the sample and its duplicate are non-detected and are in agreement. A background set of soil samples from Site 1 was analyzed for the radioactivity parameters. All results are non-detected.

One set of duplicate water samples (IANG-1-MW8 and MW9) was analyzed from Site 1. Both samples were all non-detected for all parameters and are in agreement. A

background water sample (IANG-1-MW6) was duplicated for radioactivity parameters and Well MW5 at Site 2 was duplicated (MW6) for these parameters. The results showed similar concentrations.

## 5.2 PRECISION AND ACCURACY

Precision and accuracy are assessed from the results obtained from the analysis of matrix spike and matrix spike duplicate samples and surrogate spiked samples.

### 5.2.1 Precision

Precision refers to the relative percent difference (RPD) in values obtained from two duplicate samples, in this case a matrix spike sample and its duplicate sample. RPD is calculated as follows:

$$\text{Relative Percentage Difference (RPD)} = \frac{2\,(C1 - C2) \times 100}{C1 + C2}$$

where:

C1, C2 = The two values obtained by analyzing duplicate samples.

Acceptable levels of precision vary according to the sample matrix, the specific analytical method, and the analytical concentration relative to the method detection limit. The data is not qualified on the matrix spike/matrix spike duplicate (MS/MSD) results alone. This information is used in conjunction with other criteria to determine the need for action.

The precision of the analyses of volatile aromatic compounds was evaluated on the basis of the RPD calculated for quantitation on a single chromatograph column. The EPA methods for these analyses provide statistical precision data as a function of concentration for individual compounds. These values are used as a guideline to assess the precision of duplicate analyses.

For Work Order 2091, four RPDs were high for the MS/MSD for water. Because they were not far out of range, the percent recoveries were all in range, no other criteria were unacceptable and no semi-volatiles were found in the only associated sample (IANGB-1-RB1), no further action was taken.

### 5.2.2 Accuracy

Accuracy refers to the correctness of the value obtained from the preparation and analysis of a sample. It is determined by comparing the analytical results of a given sample and its corresponding matrix spike sample. Surrogate compounds added to each sample also make it possible to evaluate the analytical accuracy. Accuracy is expressed as percentage recovery (PR) and is calculated using the following formula.

$$\text{Percentage Recovery (PR)} = \frac{Ss - So}{S} \times 100$$

value:

So = Background value, the value obtained by analyzing the sample before spiking;

S = Concentration corresponding to the spike addition to the sample; and

Ss = Value obtained by analyzing the matrix spike sample with the spike added.

The degree of accuracy, or PR, to be expected is dependent upon the sample matrix, specific analytical method, and the concentration of the analyte relative to its detection limit. The closer the measured value is to the detection limit, the lower the accuracy of analysis.

The procedures for spike samples to be analyzed by gas chromotography are described in the method. The expected range for recoveries of each compound are also provided in the method description.

If quality control results demonstrated an out of control situation for the spiked sample or spiked duplicate sample, a corrective action was taken. This may have included checking the calculations, flagging data in accordance with the procedures prescribed for the method, recalibration of the instrument, and/or re-analyses of the samples.

In Work Order 2091, the surrogate for the volatile organics for sample IANG-1-SB1-S2 was out of range. As required, the laboratory reextracted and reanalyzed. Again, the surrogate was out of range. The data from the first analysis was used and flagged as estimated (J).

The semivolatile organic analysis for Work Order 2169 had several poor surrogate recoveries for most of the groundwater samples. The samples were reextracted and in general the surrogate analysis of the reextracts was not better. The final actions are presented below. Details are discussed fully in the validation notes in Appendix I. Sample defueling pit water (2169-01) was reextracted and the surrogates were in range. Since the reexact was out of holding time, the results were flagged as estimated. The results of the original extract of MW5 (2169-02) were used with the base neutal (BN) fraction flagged as estimated. For samples MW6 (2169-03) and MW8 (2169-05), no reextracts were performed due to lack of sample. Since three BN were high for both samples, all BN were flagged as estimated. The results of sample MW7 (2169-10) are all flagged as unusable (R) since both extracts have at least two recoveries less than ten percent.

In summary, the semivolatile organics for Work Order 2169, are flagged due to poor surrogate recoveries. Since the blank surrogate recoveries were good and the soil surrogate recoveries were good for this Work Order, it seems likely that this is a matrix effect.

## 5.3 COMPARABILITY

Comparability qualitatively expresses the confidence with which one data set can be compared with another. The analytical methods used for this investigation are documented standard methods. Although CLP methods were not used for every analysis, CLP-type data packages were received for each analytical method. Future investigations using the same standard methods can be compared to this investigation.

## 5.4 COMPLETENESS

The completeness of the data is the percentage of analyses which are judged to be valid and is determined by calculating the number of invalid analyses. Invalid analyses can include those analyses which were not performed by the lab or those analyses which are disqualified due to quality control problems. One semivolatile organic analysis (sample IANG-1-MW7) was flagged as invalid due to very low surrogate recoveries. Since the rest of the analyses are considered valid, the goal of 90 percent completeness was achieved.

## SECTION 6

## SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This Section presents the Conclusions and Recommendations for Site 1 and Site 2 of the Iowa ANG. The findings and results of the SI are summarized below. Based on the results, recommendations are made to address existing conditions.

Site 1 is a former defueling pit where excess JP-4 was dumped from aircraft during the period between 1961 and 1974. An estimated 180,000 gallons of JP-4 may have been released at this site. The following are activities conducted during the SI:

- Soil-gas survey
- Installation of three piezometers
- Installation of eight monitoring wells, including soil samples
- Sampling of soil and water at the surface of the defueling pit
- Groundwater sampling from wells without phase-separated hydrocarbons
- The soil and groundwater at Site 1 are contaminated with volatile petroleum hydrocarbons, the components of JP-4 fuel.
- The preliminary risk assessments show that presently there are no completed exposure pathways. Future pathways may be completed depending on the land use.
- The extent of contamination has been generally defined, however, further investigation is recommended along with simultaneous and immediate remedial activities.

Site 2 is the possible low-level radioactive waste disposal area. This site is a small area ten feet by ten feet enclosed by a dilapidated fence. Inside the fence are three metal casings. It is our understanding that this area was used by the Air Force for the disposal of low-level radioactive wastes, such as radio tubes. The following activities were conducted at the site during the SI:

- Surface radioactivity survey
- Magnetometer survey
- Installation of five temporary monitoring wells
- Collection of soil and groundwater samples for radioactivity analyses
- Removal of temporary wells.

Results of analyses for gross radioactivity and radium showed the soil samples from this site to be at or within average soil concentrations. Soil samples collected cross-gradient and approximately 3500 feet away showed higher concentrations of gross alpha which exceeded expected averages. Groundwater results from the temporary

wells on site showed three wells exceeding the MCL for combined gross alpha/radium 226. The cross-gradient, background well exceeded the MCL for combined radium 226/228 and the MCL for gross alpha/radium 226.

The results of the investigation at this site show background concentrations of gross radioactivity is present and naturally occurring within the local sediments and not a result of Air Force or National Guard activities.

It is recommended that a decision document eliminating this site from further investigation be prepared with the available data.

# SECTION 7

# REFERENCES

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# APPENDIX A

# MONITOR WELL DEVELOPMENT LOGS

REV. DATE: JAN 1989

# WELL DEVELOPMENT LOG

WELL NO.: IANG-1-MW-2

Page 1 of 1

Installation: Iowa Air National Guard

Site: 1

Project No.: 2390

Client/Project: Iowa Air National Guard

HAZWRAP Contractor: ES

Dev. Contractor:

Dev. Start: ( : __m)

Dev. End: ( : __m)

Csg Dia.: 2"

Developed by: Fox Drilling

Dev. Rig (Y/[✓ N])

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 25.02 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 25.02 | medium | silty/ brown | 16.7 | 6.9 | 800 | 8/17/90 |

REV. DATE: JAN 1989

# WELL DEVELOPMENT LOG

WELL NO.: IANG-1-MW-5
Page 1 of 1
Installation: Iowa Air National Guard
Site: 1
Project No.: CL390
Client/Project: Iowa Air National Guard
HAZWRAP Contractor: ES
Dev. Contractor:
Dev. Start: ( : m)
Dev. End: ( : m)
Csg Dia.: 2"
Developed by: Fox Drilling
Dev. Rig (Y / [✓ N])

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 24.58 Maximum drawdown during pumping NA ft at NA gpm
Range and Average discharge rate NA gpm
Total quantity of material bailed NA
Total quantity of water discharged by pumping 40 gal.
Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 24.58 | medium | silty/ brown | 14.4 | 7 | 800 | 8/14/90 |

REV. DATE: JAN 1989

| | | |
|---|---|---|
| **WELL DEVELOPMENT LOG** | WELL NO.: IANG-1-MW-6 | Page 1 of 1 |
| Installation: Iowa Air National Guard | | Site: 1 |
| Project No.: 66370 | Client/Project: Iowa Air National Guard | |
| HAZWRAP Contractor: ES | Dev. Contractor: | |
| Dev. Start: ( : __m) | Dev. End: ( : __m) | Csg Dia.: 2" |
| Developed by: Fox Drilling | | Dev. Rig (Y/[✓ N]) |

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 20.87 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 20.87 | medium | silty/ brown | 14.4 | 7.1 | 700 | 5/14/90 |

REV. DATE: JAN 1989

| | | |
|---|---|---|
| **WELL DEVELOPMENT LOG** | WELL NO.: [illegible] | Page 1 of 1 |

Installation: Iowa Air National Guard | Site: 1

Project No.: CL390 | Client/Project: Iowa Air National Guard

HAZWRAP Contractor: ES | Dev. Contractor:

Dev. Start: ( : __m) | Dev. End: ( : __m) | Csg Dia.: 2"

Developed by: Fox Drilling | Dev. Rig (Y/ [✓ N])

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 24.44 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water ES [illegible]

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 24.44 | medium | silty/ brown | 13.8 | 6.9 | 700 | 8/14/90 |

REV. DATE: JAN 198[illegible]

| | | |
|---|---|---|
| WELL DEVELOPMENT LOG | WELL NO.: IANG-1-MW-8 | Page 1 of 1 |

| | |
|---|---|
| Installation: Iowa Air National Guard | Site: 1 |
| Project No.: 2370 | Client/Project: Iowa Air National Guard |
| HAZWRAP Contractor: ES | Dev. Contractor: |
| Dev. Start: ( : __m) | Dev. End: ( : __m) Csg Dia.: 2" |
| Developed by: Fox Drilling | Dev. Rig (Y/[✓ N]) |

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 22.70 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 22.70 | medium | silty/ brown | 14.4 | 6.9 | 800 | 8/14/90 |

REV. DATE: JAN 1989

| | | |
|---|---|---|
| **WELL DEVELOPMENT LOG** | WELL NO.: TW-1 | Page 1 of 1 |
| Installation: Iowa Air National Guard | | Site: 2 |
| Project No.: 11,370 | Client/Project: Iowa Air National Guard | |
| HAZWRAP Contractor: ES | Dev. Contractor: | |
| Dev. Start: ( : __m) | Dev. End: ( : __m) | Csg Dia.: 2" |
| Developed by: Fox Drilling | | Dev. Rig (Y/[✓ N]) |

Dev. Method Boiled water from well

Equipment Teflon bailer

Pre-Dev. SWL 26.02 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 26.02 | medium | silty/ brown | 13.3 | 6.9 | 1750 | 8/13/90 |

REV. DATE: JAN 1989

| | | |
|---|---|---|
| **WELL DEVELOPMENT LOG** | WELL NO.: TW-2 | Page 1 of 1 |
| Installation: Iowa Air National Guard | Site: 2 | |
| Project No.: CL390 | Client/Project: Iowa Air National Guard | |
| HAZWRAP Contractor: ES | Dev. Contractor: | |
| Dev. Start: ( : __m) | Dev. End: ( : __m) | Csg Dia.: 2" |
| Developed by: Fox Drilling | | Dev. Rig (Y/[✓ N]) |

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 25.88 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 25.88 | medium | silty/ brown | 13.8 | 7.0 | 1700 | 8/13/90 |

REV. DATE: JAN 1989

# WELL DEVELOPMENT LOG

WELL NO.: TW-3

Page 1 of 1

Installation: Iowa Air National Guard

Site: 2

Project No.: CL390

Client/Project: Iowa Air National Guard

HAZWRAP Contractor: ES

Dev. Contractor:

Dev. Start: ( : __m)

Dev. End: ( : __m)

Csg Dia.:

Developed by: Fox Drilling

Dev. Rig (Y / [✓ N])

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 25.36 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 25.36 | medium | silty/<br>brown | 13.8 | 7.0 | 1800 | 8/13/90 |

REV. DATE: JAN 198[illegible]

|  |  |  |
|---|---|---|
| WELL DEVELOPMENT LOG | WELL NO.: TW-4 | Page 1 of 1 |
| Installation: Iowa Air National Guard | | Site: 2 |
| Project No.: CL310 | Client/Project: Iowa Air National Guard | |
| HAZWRAP Contractor: ES | Dev. Contractor: | |
| Dev. Start: ( : —m) | Dev. End: ( : —m) | Csg Dia.: 2" |
| Developed by: Fox Drilling | | Dev. Rig (Y/N) |

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 25.52 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 25.52 | medium | silty/ brown | 14.4 | 6.9 | 1200 | 8/13/90 |

REV. DATE: JAN 1989

| | | |
|---|---|---|
| **WELL DEVELOPMENT LOG** | WELL NO.: TW-5 | Page 1 of 1 |
| Installation: Iowa Air National Guard | | Site: 2 |
| Project No.: CL390 | Client/Project: Iowa Air National Guard | |
| HAZWRAP Contractor: ES | Dev. Contractor: | |
| Dev. Start: ( : __m) | Dev. End: ( : __m) | Csg Dia.: 2" |
| Developed by: Fox Drilling | | Dev. Rig (Y/ [✓ N]) |

Dev. Method Bailed water from well

Equipment Teflon bailer

Pre-Dev. SWL 25.84 Maximum drawdown during pumping NA ft at NA gpm

Range and Average discharge rate NA gpm

Total quantity of material bailed NA

Total quantity of water discharged by pumping 40 gal.

Disposition of discharge water 55 gallon drum

| Time | Volume Removed (gal) | Water Level ft.BTOC | Turbidity | Clarity/ Color | Temp. °C | pH | Conductivity | Remarks |
|---|---|---|---|---|---|---|---|---|
| NA | 40 | 25.84 | medium | silty/ brown | 13.8 | 7.1 | 1200 | 8/13/90 |

# APPENDIX B

# FIELD NOTES

IANG

Site Log Book Notes

IANG 7/10/90

Weather: 80° F, sunny

0815 Field Team

tory

K. Palombo
T. Benson
J. Hanson
S. Fiore

ES

Arrived @ site 0800, waited for G. Prescott to meet us.

TAB 7/10/90 ~~0900 Capt. Gary Prescott~~

Reviewed PMP + SAP, looked over site maps.

vey

0900 Capt. Gary Prescott met us at the gate. Escorted us to Alert Hangar (241) where we will set up an office and store field gear + equipment. There we discussed field activities

②

and Base proceedures.

0930 We transported all ES field gear + equipment from storage locker to Alert Hangar 241.

1045 Began setting up grid for soil gas survey @ Site 1 - Defueling Pit.

TAB 7/16/90

1120 ~~&~~ Finished gridding for soil gas survey, left site for lunch.

1245 After lunch picked up generator @ SOO Rental for soil gas hammer-drill.

TAB 7/16/90

~~0115~~

1315 Arrived back @ TANGB Began drilling holes through concrete apron near Site 1 - Defueling Pit for soil gas probe.

1400 I began taking inventory of sample jars + bottles shipped to the Base from ES lab in Berkeley, CA.

1630 Finished drilling 9 holes through concrete apron for soil gas survey. Finished jar/bottle inventory. Pace + compass survey of concrete apron.

1700

Finished pace + compass survey, made list of additional field supplies and went to purchase them.

1715 Left site for supplies

③

(4)

1800 Finished purchasing additional field supplies.

T. Bunson

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TANGIS 7/17/90 (5)

Weather: 80°F, overcast, rain.

0800 Arrived @ site and met with Capt. Prescott about access to Site 2: Potential Low Level Radioactive Waste Site. Prescott's busy with phone calls, will meet us later around 1000.

0900 Field team same as recorded on page 1. Set up for soil gas survey @ Site 1 - Defueling Pit.

I made phone calls to Iowa Public Service to cancel meeting with utilities for line locations. Re-scheduled meeting for 7/19/90 @ 0800.

1030 IANGB personnel escorted us to Site 2 - Rad. Waste Site for recon. Reconned Site 2, questioned Base escort (Munitions maintenance personnel) about the site. He will check on getting us a key for access through gates when we do radiation survey, magnetometer survey, and borings / well installation. Returned to Alert Hangar 241.

1100 Marked piezometer and monitor well locations with stakes @ Site 1

1130 Went to lunch and returned generator to Soo Rental. Stopped @ store for paper spool for Gas Chromatograph (GC).

1300 Met with Capt. Prescott for applications for Airport Security Access. K. Palombo and myself filled out applications for security access and faxed them to ES-Cleveland for signatures. They will fax to Sioux Gateway Airport Authority.

1430 Returned to Alert Hangar 241. K. Palombo & J. Hansen took equip + went

(8)

to Site 2 - Rad. Waste Site
to perform radiation
survey. S. Fiore & myself
are preparing to conduct
soil gas survey after
calibration corrections were
made by S. Fiore on
GC.
1500 Began soil gas survey
sampling.

1620 Palombo + Hansen returned
from Site 2, finished Rad.
survey.
1645 Fiore & I finished
soil gas for today. Wrote
up field notes while GC

(9)

finished running analyses.
1715 GC analyses finished
Left site for the day

T. Benson

(10)

IANGB 7/18/90

Weather: 80°F, overcast

0800 K. Palombo + I met w/ D. McWilliams of Sioux Gateway Airport Authority to be tested for security authorization permits.

0900 Returned to Alert Hangar 241 and prepared for magnetometer survey at Site 2 while S. Fiore + J. Hauser continued soil gas survey @ Site 1.

1030 Escorted by Munitions personnel to Site 2 for ~~Rt.~~ 94 mag. survey. Set up grid for mag. survey

TAD
7/18/90

(11)

1230 Returned to Alert Hangar 241 to go to lunch

1330 Returned from lunch and continued mag. survey @ Site 2 and soil gas survey @ Site 1.

1740 Returned from mag. survey @ Site 2 to Alert Hangar 241. Soil gas survey still in progress. Gel Cell Battery pack for sampling pump needs to be recharged.

1800 Left site for the day.

T. Benson

⑫ IANG B 7/19/90

Weather: 70°F, rain

0800 Field team same as on page 1. Arrived @ Alert Hangar. S. Fiore + J. Hansen continued soil gas survey. K. Palombo + I went to gate to meet utilities personnel. Took to Site 1 + 2 to locate electric, phone, + gas.

~~TAB~~ ~~1000 K. Palombo + T. Benson~~
1-19-90 ~~went to Site 2 to finish~~
~~mag. survey.~~
~~1230 Called Fiore + Hansen~~

(13)

1000 K. Palombo + T. Benson went to pick up security access passes, not ready, we will try later.

1200 Met drillers @ gate as we were leaving for lunch, took them to Site 1 to set up decon pad.

1300 Went to lunch

1400 Returned from lunch, K. Palombo + T. Benson continued mag. survey @ Site 2. S. Fiore + J. Hansen continued soil gas survey @ Site 1.

1630 Finished mag. survey and returned to Alert Hangar.

⑭

1700 Finished field notes and left site ~~@~~ TAB 7-19-90 for the day.

T. Benson

---

IANGB 7/20/90 ⑮

Weather: 80°F, sunny

0800 Arrived @ Site 10 Alert Hangar 24. Talked to drillers about decon pad. The drillers need lumber for sides of decon pad, went to buy it.

0830 Equipment to be shipped back to office is being packed up.

1045 J. Hansen went to shipped TAB 7-20-90 equip. back to E.S-Cleveland office.

1100 Drillers return with lumber and start building

(16)

decon pad. sides of
decon pad are ~2' high
and will be covered with
plastic (visqueen).
K. Palombo took pictures
of Site 1. Metal detector~~s~~ TAB 7-2-90
showed possible metallic
object under location for
one of three piezometers.
K. Palombo moved piezometer
location to cleared location
~15' southwest.
1215 J. Hansen returned
from Federal Express office.
Drillers finished setting up
decon pad and left site
for home. They will pick up
more drilling supplies @ shop.

17

1300 We moved field
equipment to Capt. Prescott's
office location (Civil Eng-
ineering). Did not want to
leave expensive equip in
Alert Hangar 241. Went
to lunch.
1400 Returned from
lunch and called ES office
in Cleveland about auditors
next week.
1500 Cleaned up around
the Alert Hangar, grouted
in soilgas holes in concrete
apron @ Site 1. Left site
for the day, flights @
~~4:00~~ TAB 7-2-90 1600.

T. Benson

TANG B 7/23/90

Weather: 80°F, sunny

0800 Arrived @ Alert Hangar 241. Fox Drilling called me @ Holiday Inn @ 0730 and informed me they were having problems with the support truck. Ben Fox said they were working on the repair.

1030 K. Palombo arrived @ Sioux Gateway Airport. We returned to Alert Hangar 241 to make phone calls. Took K. Palombo to Holiday Inn to check in. went back to Alert Hangar 241 to wait there for J. ~~Dunkin~~ TAB 7/24/90 Duncan

to arrive from Atlanta ES office.

1330 K. Palombo & I went to lunch. We left message with guard for J. ~~Dunkin~~ TAB 7/24/90 Duncan to meet us at Oehler Restaurant.

1430 J. ~~Dunkin~~ TAB 7/24/90 Duncan from ES Atlanta arrived @ restaurant. We drove back to Alert Hangar 241 and showed J. ~~Dunkin~~ TAB 7/24/90 Duncan Site 1 & 2. Talked about audits.

1700 Left Alert Hangar 241 for the day.

T. Dawson

IANG 7/24/90

Weather: 70°F, overcast

0800 Field Team: K. Palombo
ES { J. Duncan
T. Benson
Fox { W. Holloman
Drlg. { D. Jovanovich

Arrived @ site 1, met drillers and had Health & Safety meeting. K. Palombo informed drillers of site locations, level D protection unless air monitoring indicates higher level of protection, need for hard-hat, steel toe shoes, no smoking on site, decon procedures for deconning rig + tools + well

casing/screen before entering ground, emergency first aid procedures in case of accident, hospital location, schedule and sequence of drilling/sampling events to be performed

0830 Drillers moving decon area to concrete pit not presently being used by IANG. Capt. Prescott gave permission to use concrete pit for decon area. Drillers constructing decon facility inside

concrete pit. Drillers also unloading semi-trailer which was delivered to the Alert Hangar before we arrived @ site Monday 7-23-90.

Trailer contains well installation equipment: sand (120 bags @ 100 lbs. ea. of 20-40), Quikrete (42 bags @ 80 lbs. ea.), Portland Cement (70 bags @ 94 lbs. ea.), Enviroplug, Wyoming Bentonite pellets, 1/4" dia. 50 - 5 gallon buckets, 6 metal manhole covers for 2" diameter wells, protective metal casings for projecting wells.

1100 Drillers begin steam cleaning + decontaminating rig and tools.

1200 K. Palombo, T. Benson, and J. Duncan went to lunch. drillers stayed @ Site 1.

1330 Returned from lunch. Drillers still deconning rig and tools

1430 Moved rig onto first piezometer location.

TAB 7/24/90 ~~1500~~ 1530 Began sanding Piezometer-1 (P-1)

(24)

1530 Breathing space air monitoring
with PID = 0.00 PPM
before drilling (background)
Lower Explosive Limit (LEL)
with Bacharach Sniffer
Combustible Gas Indicator
less than 10% explosibility

1645 Charlie Lutz with
TAB 7-24-90 Martin Marietta ~~HAZWRAP~~ arrived @ Site 1
He will be back tomorrow
7-25-90 for HAZWRAP audit.
Drillers took break while we talked
TAB 7-24-90 ~~TTYS~~ to Charlie Lutz.

1715 Drillers began sampling
@ ~~72'~~ 16'
TAB 7-24-90

1730 Took last soil sample
of the day. Willie needs to
get fan belt for rig. Stopped
drilling @ 20' deep, moist
fine-grained sand, have not
reached water table yet.
Cleaned up site and left
for the day @ 1800.

TAB 7-24-90

(26)

FANG 7/25/90

Weather: 70's F, partly sunny, breezy

0815 Arrived @ site 1

Field Team: K. Palombo, T. Benson, J. Duncan } ES
C. Lutz } Martin Marietta
T. Cady } HAZWRAP

Showed T. Cady around site 1.

Willie fixing fan belt on rig.

0840 Ready to begin drilling from depth where we stopped yesterday 7-24-90 @ 25'.

No water in borehole.

0900 LEL < 10% (bkgd < 10%)

Breathing Space (PID) = 0.00 (bkgd. 0.00)

(27)

calibrated PID w/ 100 ppm isobutylene

0915 K. Palombo, J. Duncan, C. Lutz, T. Cady went to Site 2 to familiarize Lutz & Cady with the site and the work previously performed and work to be performed there.

0940 Field Team @ Site 2 returned to Site 1.

0930 Hit water table @ 25'

0950 Took 28'-30' sample wet, some hydrocarbon odor

K. Palombo, J. Duncan + T. Benson decided to set P-1 @ 31' with 6' of screen below water table and 4' above.

(28)

1000 J. Duncan left for Atlanta.

1040 K. Palombo took photos of IANG Fire Training Area near the Munitions Depot at T. Cady's request.

1050 Returned to Site 1. Drillers washing piezometer screen and casing w/ liquinox then steam cleaning screen + casing.

1100 T. Cady left for Oak Ridge.

1110 Augered to 32' and attempted to install piezometer but sand heaved up inside auger is preventing installation. Willie trying to push sand out of augers.

(29)

1115 Rain has stopped drilling operations temporarily.

~~1130~~ TAB 7/25/90

1145 K. Palombo, T. Danson, C. Lutz went to lunch. Drillers Willie & ~~Bag~~ Drag TAB 7/25/90 stayed on Site 1.

1300 Returned from lunch. Drillers getting ready to install piezometer. Tripped down hole with rollerbit to unplug augers.

1330 Unplugged augers and installed piezometer P-1

TBB 7/25/90

Bottom of screen @ ~~31.5~~ ③1'

top of screen @ ~~21.5~~ ㉑' TBB 7/25/90 below grade.

1400 P-1 sand from 31' to 19', bentonite pellets from 19' to 17'

2½ bags of sand (100 lb. bags) and 50 lb. bent. pellets (1 bucket)

Hydrated bentonite pellets

1420 Began to pull augers out of borehole.

1430 C. Lutz auditing field books.

1445 Drillers began deconning augers and rig.

1515 T. Benson took K. Palombo to airport

1545 Returned from airport. Drillers still deconning augers & rig

1615 C. Lutz went to airport to check schedules for departing flights tomorrow 7-26-90.

1715 Water level in P-1 26' from grade strong product odor possible free product.

Rain started up again

(32)

1745 Rain has postponed drilling for the day. Left site.

DAB 7-25-90

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I.A.N.G. 7-26-90 (33)

Weather: 65-70°F, overcast, predicted rain

0800 Arrived @ Site 1. Drillers (Willie + Drag) already on site.

0830 Moved rig to 2nd piezometer (P-2) location, set up for boring/sampling.

0900 Began sampling (continuous) P-2 boring.

1000 Willie + Drag trying to fix spoons. Stainless steel spoons have become difficult to assemble due to

(34)

the softness of the steel
and the wear from use.
Filing threads and edge
grooves seems to temporarily
alleviate the problem.

1010 Sampling again.
C. Lutz arrived @ Site 1.
Talked about audit, I
signed the Findings + Observa-
tions checklist, in agreement
with and aware of his comments.
1030 C. Lutz left site
for airport
1040 I have to calibrate
PID. Having trouble due to
(with calibration)
humidity.

(35)

1100 Calibrated PID to
zero @ ambient air and
100 ppm isobutylene span gas.
Drillers spreading cuttings
around on ground surface.
PID indicates VOC < 100 ppm
in these cuttings. All
cuttings from P-2 will be
drummed from now on.
At 9' hydrocarbon odor
and high VOC levels were
detected in the samples.
Hence, cuttings shallower
than 9' were not drummed,
cuttings deeper than 9'
will be drummed.
Breathing air space monitoring
PID = 0.00 ppm
LEL < 10% (zeroed to ambient air)

1230 Finished sampling P-2. Encountered water table @ 24.5', sampled to 30'. Hydrocarbon (HC) odors from 9' to 30'. Slight H-C sheen on water inside spoon @ 24.5', sample S-13.

1240 IANG personnel informed Willie of airplane engine testing being performed in the hush box near the decon pit. We will not be allowed back in the decon area until testing is completed. I gave go ahead to wash and rinse piezometer casing & screen with liquinox + clean rinse water before P-2 installation.

1245 Re-charging one of the MicroTip batteries in bomb storage hangar next to our office.

Willie & Doug deconned P-2 casing & screen and began installation.

1340 Finished P-2 installation. Cannot decon augers yet due to engine testing procedures.

1430 I called ES-Cleveland office and talked to K. Palombo about audit.

J. Duncan, ES-Atlanta called about audit

1500 I left site
to try to find product detecting
paste. Need to check P-1
for product, interface probe
will not fit inside piezometer.

Siouxland Engineering
called about product finding
paste I had called about
earlier. They are also working
on the IANGB. I went to
look for them where Capt.
Prescott thought they were
working. I did not find
them. Went to buy string
to lower empty VOA vial
down P-1 for product

detection.
1620 Returned to site

1645 IANG personnel
performing jet engine testing
moved jet. Willie & Dray
set up for steam cleaning.
I found product in P-1
with 1/2" diameter pvc casing
rigged into small bailer and
lowered into P-1. Product is
clear, smells like disel and
kerosene mix - jet fuel.
1730 Tried to call Capt. Prescott
but he is gone for the day.
Tried to call C. Lutz @
Martin Marietta to leave

message, but Basa [illegible] TOB 7-26-90
switchboard gone for the
day. Will try C. Lutz from
hotel room.

1800 Dreg steam cleaning
for piezometer installation
(P-3) tomorrow and Site
2 boring/sampling

1845 Left site for the
day.

1340 – 1645 (3 hrs) standby for
Willie + Dreg due to jet engine
testing

T. Benson
7-26-90

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IANG 7/27/90

Weather: 70s °F, partly
sunny

0800 Arrived @ Site 1,
Willie + Dreg on site.
I called F. Palanko to
inform him of free product
in P-1. He will inform
Hazwrap or Martin Marietta
or Guard

0830 I went to make boring
log copies @ Capt. Prescott's
office.

0845 Returned to Site 1
and set up for sampling

0900 Began boring/sampling
P-3.

(42)

Calibrated PID: Zeroed to
ambient air; span gas to 100
ppm isobutylene.

Calibrated LEL: Zeroed to
ambient air

Filled out field variance
TAD 7/27/96
form for ~~switching~~ changing
from stainless steel split spoons
to metal spoons due to time
and work involved in filing
spoon edges and threads to
allow assembly of spoons after
cleaning. Piezometer samples
will not be analyzed by lab,
only field screened for VOCs.

(43)

1045 Breathing Air Space
Monitoring
PID = 0.00
LEL < 10%

1100 Hit Hydrocarbon
odors in S-9 sample @ 17'.
Cleared uncontaminated soil
away from augers, will drum
all soil cuttings from 17' to
total depth.

1215 Finished sampling
began P-3 installation
1300 Finished P-3
installation
1315 Began steam cleaning.
E. Palumbo called, wants

(44)

Well Wizard or Interface
Probe sent back to Cleveland.
I'll send interface probe.

1345 I went to make
copies @ Prescott's office and
get some lunch.

1410 Returned to site 1,
Willie + Drag done steaming

1415 Called Munitions
to get to Site 2. Ebner
said they'd be out in 1/2
hour.
1500 I called Munitions
and asked about the weekend.

9

(45)

He told me someone would
be working the weekend to
open gates @ Site 2.

1515 Munitions personnel
escorted us to Site 2.

1530 Willie looked over
site, began to set up
for boring.

1550 Started Sampling.
Geiger-Mueller (Eberline E-100)
[CPM] 0-100 background; factory calibrated
1630 Stopped boring due
to thunder/lightening storm.
1710 Called Security for
escort out of Munitions area.
1730 Left site for the day.
T. Benson 7/27/9

IANG 7/28/90

Weather: 80°F, overcast

0700 Arrived @ site 1 and waited for drillers to arrive.

0710 Drillers arrived. Weather was threatening to storm, so we waited to determine if it was safe to drill.

0730 Called Security Police for escort to site 2.

0740 Security arrived and escorted us to Site 2.

0750 Began sampling @ Site 2, SD-1 for the day.
(Eberline E-120) bkgd.
Geiger-Mueller: factory cal.; 50-100 CPM

0930 Hit water table @ 22.5'.

1015 Finished boring SB-1, began well installation

1045 Need more sand and tremie equipment to set bentonite backfill in temporary wells at Site 2.

1100 Called Security to unlock gates.

1115 I left drillers @ Alert Hangar, while they loaded up supplies I went to get ice for samples + drinks.

1140 Returned to Alert Hangar, called Security, we drove out to gates, and site.

1200 Continued installation of TANG-2-MW-1.

1245 Finished installation of TANG-2-MW-1

TAB 7/20/90
~~Moved to next location~~

1300 Steam cleaned equip at decon area.

1400 Returned to Site 2. Moved to SB-2 location and began sampling.

1530 Hit water table @ 24.5'

1600 Thunder/lightening storm stopped drilling for the day

1615 Drillers left for the day I stayed @ Alert Hangar and packaged samples for lab.

1930 I left site for the day.

T. Benson
7-28-90

(50)

IANG 7/29/90

Weather: 80s F, sunny

0700 Arrived @ Alert Hangar 241, drillers on site. Loaded up supplies and went to site 2 w/ Security escort.

0730 Arrived @ Site 2. Ground is wet, Willie concerned about getting support truck stuck in wet mud. I drove rental car around site, ground appears solid enough. Willie drove on to site.

0800 Began installation

(51)

TAB 7/29/90

of ~~TMW~~ IANG-2-MW-2 Casing and screen was decontaminated with liquinox + water wash, tap water rinse, DIUF water rinse. Installed temporary well IANG-2-MW-2 to 31'.

0930 Came back to Alert Hanger to decon augers + equipment.

1000 Started deconning, I went to get drinks and try to find water finding paste. Could not find paste.

1045 Returned to Base. Still deconning. I got water levels in piezometers.

(52)

Used Well Wizard for water levels. Could see where product level was on plastic tape above water sensor. Strong product odor in P-1 + P-2.

P-1 and P-2 showed product thickness of ~2'. No product in P-3.

1200 Finished steam cleaning.

I took rinse blank samples after decoming steamed spoon with liquinox + water wash, tap water rinse, DIUF water rinse, methanol rinse.

1230 Back @ Site 2

Set up on next boring

---

(53)

location, TANG-2-SB-3.

Began sampling. Geiger-Mueller (Eberline E-120) factory Cal.; bkgd. 50-100 CPM

1440 Hit water table @ 22.5', slight decaying organics odor

1540 Finished sampling / boring. Began installation of temporary well TANG-2-MW-3

DUP Took duplicate sample of S-11 20'-22'.

TANG-2-SB-3

Log # S-11 = Lab sample # S3

Lab sample # S3 = S4 (Duplicate)

1700 Finished temp.
well IANG-2-MW-3
installation. 1700-1800 Decon.
1800 Moved to next location
SB-4 @ Site 2
1805 Began boring/sampling
IANG-2-SB/MW-4.

1830 Stopped boring for the
day. Called Security for
escort out of Site 2.

1800 Labeled samples
for shipment to lab 4 Yarrow,
packed up cooler.
TMB 7/30/90 ~~1900~~ 1930 Left site for the
day

T. Benson 7/29/90

IANG - 7/30/90
weather: 80°sF, sunny

0700 Arrived @ Site 1.
drillers loading up sand,
water & bentonite for
Site 2.

Sent them out to Site 2.
I had to survey piezometers
@ Site 1, then ~~sent~~ fax TAB 7/30/90 logs,
survey notes, water/product
elevations to Cleve. office.

1130 Arrived @ Site 2.
drillers installing temp. well
IANG-2-SB/MW-4

(56)

1300 Finished installation DUP
of temp. well + cleaned up.
~~moved to next location.~~
TAB 7/29/90 ~~background well~~
1300 - 1400 Decon equip.
Geiger-Mueller (Eberline E-120)
factory calibrated; 50-100
counts per minute (CPM) =
background
1400 Moved on to background
well @ Site 2, IANG-2-SB/MW-5
Began sampling.

1530 Hit water table @
24.5'
1550 Finished boring.
began well installation.

---

(57)

Took duplicate sample
of S-11 20-22'
IANG-2-SB-5-
Log # S-11 = Lab sample # S3

Lab sample # S3 = S4 (Duplicate)

TAB 7/30/90 1700 ~~1600~~ Finished installation
of temp. well IANG-2-MW-5
Cleaned up and left Site
2.
Willie + Dreg steam cleaning
equip @ decon area.
1800 I left site for
Federal Express office
to ship water level indicator
back to office.
T. Benson 7/30/90

JANG 7/31/90

Weather: 80'sF, sunny

0700 Arrived @ site 1,
Willie & Doug loading up
equipment & water.
I took rinse blank sample
from 7/30/90 before starting
drilling for today.

Called Capt. Prescott,
informed him of the free-
floating hydrocarbons (JP-4
fuel) in P-1 & P-2. He
said he had already been
informed by Guard personnel.
Capt. Prescott was out of the
office on Friday 7/27/90

and Monday 7/30/90. I
could not reach him on
Base during those days.

0800 Moved drilling rig
on to first boring location
and began sampling.
Decon procedures: liquinox
and water wash, tap water
rinse, DIUF water (De-ionized
Ultra Filtered) rinse, methanol
rinse, air dry.

PID calibration: zero to
ambient air, span gas = 100 ppm
isobutylene

(60)

Breathing Air Monitoring:

PID = 0.0 ppm

LEL = < 10% explosibility

LEL Calibration: zero to ambient air, factory calibrated to hexane.

0930 Hit hydrocarbon odor in samples @ 14'.

0945 All cuttings shallower than 14' were removed from around augers and spread out around site. All cuttings from 14' and deeper will be drummed.

(61)

1010 Resumed boring/sampling.

1030 Hit water table @ 24'.

1100 Finished boring @ 30', set up for IANG-1-MW-1 installation

1245 Finished installation of IANG-1-SB/MW-1, still grouting to surface

TAB 7/31/90 ~~1380~~ 1330 Deconning augers & equipment @ decon pad

1500 Finished steaming equip, I took rinse blank after decontaminating steamed spoon: liquinox ^tap water wash, tap water rinse, DIUF water rinse

1530 Began boring IANG-1-SB-2.

1700 Finished boring for the day @ 10'

1900 I stayed and labeled all samples, packed coolers did chain of custody, called

ES lab in Berkeley, CA about billing to CEP in Santa Fe, NM.

Left site for the day.

T. Benson 7/31/90

(64) IANG 8/1/90

Weather: 80's °F, sunny

0700 Arrived @ Site,
drillers already here.

Continued sampling IANG-1-
SB-2.

PID calibration: zero to
ambient air, span gas = 100ppm
isobutylene

LEL calibration: zeroed to
ambient air, factory calibrated
to hexane

(65)

Breathing Air Space
Monitoring:
PID 0.0 ppm
LEL <10% explosibility

0830 K. Palombo called to
inform me that HAZWRAP
wants to abandon the boring
currently being sampled and
move to a location south of
the defueling pit on the
concrete. I acknowledged
and informed the drillers of
that decision. Defining the
edge of the product plume
is the objective in re-locating

the previously set-up grid
for monitor well locations.
0930 Drillers are abandoning
JANG-1-SB-2 by installing
a bentonite/cement grout
from the bottom of the boring
to ground surface. Bentonite is
Super Gel-X, Extra High
Yield Drilling Fluid, made
by American Colloid Company.
A 5% bentonite / Portland Cement
grout was mixed in a grout
tub and ~~pumped~~ tremied into the bore-
hole. TAB 8/1/90
1030 Finished grouting
borehole. Took rig to decon
area to steam clean.

1030 Steam cleaning
augers + equipment.

1200 Finished steaming
equipment. Drillers mixed
and added more cement
to abandoned borehole.
I made copies of paperwork.
1300 set-up on new location
for perimeter well ~100'
south of P-1 on concrete.
This is ~~JANG-1-SB/MW-2~~ JANG-1-SB-3/MW-2, TAB 8/7/90
approximately half way between
the defueling pit and the
Alert Hangar.
1400 Still boring through
concrete with lead auger +

center bit. I'm labeling
samples and packing coolers
for Fed-X.

1500 Through concrete and
into soil sub-base.

1530 Drillers cleaned up
site and left for four days
off. Did not want to start
sampling and have to leave
rig set up over borehole on
the concrete for four days.

1700 I finished paperwork,
and prepping samples for
lab. Took to Fed.-X and

shipped out. Also Fed-X'd
time sheet and expenses to
Carol Bowers and shipped
hand lens to Jim Duncan,
ES, Atlanta. Finished
for the day.

T. Hanson 8/1/90

(70)

IANG- 8/2/90

Weather: 80°F, partly sunny

1050 Came out to site to move equip to Capt. Prescott's office & get water/product levels.

| | | |
|---|---|---|
| IANG-1-MW-1 | 23.25<br>Prod | 25.00<br>water |

Interface Probe detected top of product @ 23.25' & top of water @ 25.00'

Product thickness : 1.75'

Clear bailer shows 1.50'

P-1 shows no product

1230 ~~1130~~ Left Site

TAB/
8/6/90

(71)

IANG- 8/6/90

Weather: 80°F, sunny

0700 Drillers on site, I arrived got equip from Capt. Prescott's office. Base has lock on office door, can't get in.

0800 Security came out with bolt cutters and cut off lock.

0830 Started boring/sampling IANG-1-SB-2 where we left off, below concrete. A gravel/sand sub-base under concrete was cleaned out by driller to

2', started sampling there.

Calibrated: PID: zeroed to
ambient air; Span gas = 100 ppm
isobutylene.

Calibrated LEL: zeroed to
ambient air; factory calibrated
to hexane

Breathing Air Space Monitoring:

0.0 ppm w/ PID
<10% LEL

1030 Hit water @ 25',
some hydrocarbon odor

TAB
8/6/90

1200 ~~1100~~ Finished boring to
32'. Drillers getting set up
for well installation.

1400 Finished well installation
up to top of bentonite pellets,
setting up for grouting to surface.

1530 Finished tremieing
bentonite/cement ~~grout~~ grout to ~1'
from surface. Cleaned up
around top of well, drummed
soil from augers.
1545 Deconning augers and
equipment with steam cleaner.

1700 Finished steam cleaning

TAB
8/6/90

equipment. I took rinse-blank
IANG-1-RB-3.

1730 Finished field notes
and left for the day.

T. Benson 8/6/90

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IANG 8/7/90

weather: 80's F, sunny

0700 Arrived @ Site 1,
drillers arrived same time.

0730 Moved to next boring
location IANG-1-SB-1/MW-3
north of P-2 ~75'.

0800 Began boring/sampling.

1045 Hit water @ 24',
odors @ 16', strong odors
directly above water @ ~23'.

1315 Finished well installation
up to top of bentonite pellets.

1400 Finished bentonite/cement grout tremie to ~2' from ground surface, Began Steam cleaning @ decon pad. I ran errands.

1500 I returned to Site. Drillers finished deconning. I talked to K. Palombo (ES) about next well location. Moved drillers on to next boring location

1530 Began boring through concrete @ IANG-1-SB-5/MW-4.

1630 Finished boring through concrete, cleaned out hole to 2' and began sampling.

1715 Sampled to 12' and finished for the day. Drillers left, I stayed to label & prep samples for lab.

1900 Finished prepping samples, will ship out tomorrow.

T. Benson
8/7/90

IANG 8/8/90

Weather: 70's F, sunny

0700 Drillers and I arrived on site, set up to continue boring/sampling on IANG-1-SB5/MW-4 where we left off yesterday.

0915 Hit water @ 25'

0930 Finished boring/sampling @ 30'. Began well installation. Augered to 32', installed well to 30'.

1200 Finished grouting to ~2' from surface.

Cleaned up concrete area around well.

1230 Jet engine testing near decon pad preventing steam cleaning augers & tools. Willie & Doug setting up to install concrete pads and flush manhole covers on wells 1-4.

Concrete pads for wells 1-4 are being installed

1630 Jet engine tests are finished for the day. Drillers moved rig to decon

pad and steamed augers + tools.

1730 I left for Fed-X office to ship samples to ES lab-Berkeley.

T. Benson 8/8/90

IANG 8/9/90

Weather: 80°F, sunny

0700 Drillers on site, loading water tank on support truck. I arrived and located next boring.

0745 Set up on IANG-1-SB-6/MW-5 ~100' SW of P-1.

0800 Began sampling.

Calibrated PID: zeroed to ambient air; spangas to 100 ppm isobutylene.

Calibrated LEL: zeroed to ambient air; factory calibrated to hexane.

Breathing Air Space Monitoring:

PID = 0.0 ppm
LEL < 10% explosibility

1100 Finished boring/sampling.

Hit water @ 24', no definite H-C odor, but a definite odor of some kind from 26' to 30' (sweet smelling, possibly hydrocarbon). No product in samples was visible. PID readings were low.

TAIS
8/4/90

1130 Set up for ~~grouting~~ well installation of IANG-1-SB-/MW-5.

Set well to 30', top of screen @ 20'.

1300 Sand pack and bentonite pellets in place, setting up for bentonite/cement grout mix backfill.

1330 Finished backfilling with grout. Cleaned up around borehole. Cuttings were uncontaminated based on screening with PID. Drillers spread cuttings around area.

1400 Received call from

(34)

Water/Product Levels

| | | DTF | DTW | Product THK. |
|---|---|---|---|---|
| IANG-1-MW- | 1 | 23.42 | 25.60 | 2.18' |
| " | 2 | 25.30 | 25.30 | 0.00 |
| " | 3 | 22.29 | 24.50 | 2.21' |
| " | 4 | 23.~~85~~ 94 | 26.10 | 2.16' |
| " | 5 | 24.30 | 24.30 | 0.00 |

TAB 8/9/90

Correction for water ~~level~~ elevation TAB 8/9/90 with floating product

X = 0.8 x product thickness (feet),

Water elevation + X = corrected water elevation

D. Edwards - ES. Need to know product thickness in wells and current water table

(35)

map. I started getting levels. Drillers steam cleaning.

1700 Measured product/water levels in all site wells presently installed (1-5). Called D. Edwards to inform him I would fax new site sketch and water table/flow direction map t'morrow morning 8/10/90.

Tried to set up on next boring location but utilities were in the way. Will contact Airport Authority in the morning.

T. Benson 8/9/90

IANG 8/10/90

Weather: 70's F, overcast,
humid

0700 Arrived @ Airport
office to check on utilities
near next boring location.
Talked to Airport personnel,
looked @ maps, went to site
and cleared boring location
with Airport personnel.

0900 Set up for boring/sampling
IANG-1-SB-7/MW-6.

1000 Hit water @ 25',
no odors.

1200 Finished boring/sampling,
it started raining, lightning.

1330 Began well installation
of IANG-1-SB-7/MW-6

1530 Finished well installation
and set bentonite/cement grout
to ~ 2' from surface.
Moved rig to decon pad
and began steam cleaning
augers + tools.

Calibrations for the day:

PID calibration: zeroed to
ambient air, span gas to 100 ppm
isobutylene.

LEL calibration: zeroed to ambient air, factory calibrated to hexane gas.

TAB
8/10/90

Split Spoon decon procedure:

- tap water + liquinox wash
- tap water rinse
- DIUF water (De-ionized Ultra-filtered) rinse
- Methanol rinse
- Air dry

1600 I went to purchase cooler for sample shipping. Ron Chew informed me the coolers he sent went to

Cheyenne, Wyoming site by mistake. ~~I told him~~ He requested I send samples Monday morn. 8/13/90 instead of Sat. 8/11/90.

1200 Drillers finished deconning. I took rinse blank and called it a day.

T. Benson 8/10/90

(90)

IANG 8/11/90

Weather: 80's F, sunny

0700 Drillers on site. I
tried to locate water line
near next boring location,
IANG-1-SB-8/MW-7, from
fax I received from D. Edwards,
ES-Cleve. @ hotel last night
8/10/90. Could not locate
water line. Set up and started
boring/sampling very carefully in
first 10'.

TAD 8/11/90 1030 ~~0830~~ Hit water @ 24', no
odors. Decon procedure for
split spoon same as page 88.

(91)

1130 Finished sampling to
30' in IANG-1-SB-8/MW-7

Calibration of PID and
LEL same as on page 87-88.

Breathing Air Space Monitoring:
PID 0.00 ppm
LEL <10% explosibility

1200 Began well installation

1315 Finished installing
screen, riser, sand + bentonite
pellets

1330 Setting up for grout
tremie.

1400 Bentonite/cement grout in place from top of bentonite pellets to ~2' from ground surface. Cleaned up around well and moved rig to decon pad to steam augers & tools

1550 Finished deconning augers + tools w/ steam cleaner

1600 located next boring/well location from map faxed to me by D. Edwards. Map showed 80' NW of P-3. Took cap off P-3 and smelled product odor. P-3 boring log showed elevated PID readings

and strong hydrocarbon odor. Initially, after P-3 installation, no product was detected nor product odor.

Began boring/sampling IANG-1-SB-9/MW-8

1800 Sampled to 20', no odor.

Decided to quit for the day and finish well t'morrow.

T. Benson 8/11/90

IANG 8/12/90

Weather: 80°'s F, partly sunny

0700 Arrived @ site, drillers here, too - Loaded up water tank with water from hydrant on site. Moved on to IANG-1-SB-9/MW-8 where we left off yesterday.

0800 Began boring/sampling @ 20'.

Hit water @ 23', no odors

Finished boring @ 30', no odors.

0900 Began well installation.

Calibrations: PID + LEL

PID - zeroed to ambient air,
span to 100 ppm isobutylene

LEL - zeroed to ambient air,
factory cal. to hexane.

Breathing Air Space Monitor:

PID 0.00 ppm
LEL < 10% explosibility

Decon spoon procedure:
same as on page 88.

1100 IANG-1-SB-9/MW-8 installation

complete up to top of bent/cement grout backfill (~2' from ground surface).

1200 Moved rig to decon pad and steam cleaned augers + tools.

1400 Took rinse blank IANG-1-RB-5, and field blank IANG-1-FB-1 of both tap water from hydrant and DIUF water.

1500 Drillers constructed concrete pads @ MW-5 thru 8.

I labeled and packed samples.

1800 Drillers left site for the day.

2000 I left for the day.

T. Benson 8/13/90

(98)

IANG 8/13/90

Weather: 70's F overcast

0700 Arrived on site 1, drillers started developing MW-2. I went to get batteries for Interface Probe.

1000 - 1100 Took water/prod. levels

Water/Product Levels

| Well # | DTF | DTW | Prod. thk. |
|---|---|---|---|
| IANG-1-MW-1 | 23.40 | 25.60 | 2.20 |
| 2 | 25.02 | 25.02 | 0.00 |
| 3 | 22.28 | 24.55 | 2.27 |
| 4 | 23.82 | 26.10 | 2.28 |
| 5 | 24.58 | 24.58 | 0.00 |
| 6 | 22.87 | 22.87 | 0.00 |
| 7 | 24.44 | 24.44 | 0.00 |
| 8 | 22.70 | 22.70 | 0.00 |

(99)

1130 Ordered and went to pick up filter for rig compressor to air lift water for well development.

1230 Drillers moved to site 2 for well development.

1300 Called CEP lab for coolers to be returned to IANG. Called ES-Berkeley lab for coolers and talked to Mike Cohen about billing and sampling questions.

1400 Still labeling, packing coolers for shipping

1630 left to make copies

(100)

of paperwork and talk to Capt. Prescott about project.
Stopped to buy small cooler for samples.

1800 Arrived Fed. EX office and began shipping out coolers and Rad. field book to K. Palombo ES.

1900 Returned to site, drillers gone. I cleaned up & left for the day.

T. Jensen 8/13/90

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(101)

TANG 8/14/90

Weather: 80° F, sunny

0700 Arrived on site, drillers here.

I made phone calls to decide about soil piles @ Site 2 and getting surveyor to survey site 2 wells ASAP.

0800 We went to dump trash (paper)

0900 Drillers started developing site 1 wells.

TAB 8/14/90 Pat ~~McConnell~~ McDonnell (ES) Cleve. is arriving this morning to assist with water sampling.

1230 Returned w/ P. McDonnell and got sampling equip. together for Site 2.

Purged and sampled wells 1-5 @ site 2, took duplicate @ MW-5, labeled it MW-6.

MW-5 36 bails

Temp = 57°F

pH = 7.1 pH

Cond = 1800
(µMhos)

1600 Finished sampling wells @ Site 2.

Deconned bailers between

each well.

Decon procedure

- Tap water & liquinox wash
- tap water rinse
- DIUF water rinse
- Methanol / rinse
- Air dry

MW-1 36 bails

Temp = 56°F

pH = 6.9

Cond = 1750 (µMhos)

MW-2 36 bails

Temp = 57°F

pH = 7.0

Cond = 1700

MW-3 36 bails
Temp : 57°F
pH : 7.0
Cond : 1800

MW-4 36 bails
Temp : 58°F
pH : 6.9
Cond : 1800

1625 left Site 2 and labeled + packed samples in coolers.

1800 Took coolers to Fed-Ex office and shipped out.

1830 Left Fed-Ex office.

T. Benson 8/14/90

Weather: 70°s F, p sunny

0700 Met drillers on site. Drillers loading up for trip home. Not much they can do today because we are waiting on Site 2 soil lab results. If contaminated, we will need more barrels. All barrels being used now.

PAB 8/17/90

Pat ~~+ I are~~ is labeling sample bottles for sampling Site 1 wells today.

Duplicate sample for volatiles is labeled MW-9, taken from IANG-1-MW-8

Duplicate sample for
gross alpha/beta + radium
226, 228's labeled MW-10,
taken from IANG-1-MW-6

Pat deconned bailers and
made out chains-of-custody
for all coolers while I ran
errands and bought supplies.

1130 Decon procedure:
- tap water + liquinox wash
- tap water rinse
- DIUF water rinse
- methanol rinse
- air dry

IANG-1-MW-2

DTW = 25.01'
Temp 62°F, 61°F
pH = 6.9, 7.0
Cond 800 (umhos), 800

TAD 8/15/90 Depth to ~~screen~~ well bottom = 30.65'
Depth to top of screen = 20.00'
30 bails = ~10 gal

IANG-1-MW-5

DTW = 24.57'

Depth to well bottom = 30.65'

Depth to top of screen = 20.00'

Temp. = 58°F, 59°F

pH = 7.0, 6.9

Cond. = 800, 800

36 bails = ~12.5 gal

IANG-1-MW-6

DTW = 22.85

Depth to well bottom = 30.50

Depth to top of screen = 20.00

Temp = 58°F, 59°F

pH = 7.1, 7.0

Cond = 900, 800

30 bails = ~10 gal

(110)

IANG-1-MW-7

DTW = 24.45'
Depth to well bottom = 30.30
Depth to top screen = 19.80

Temp = 57°F, 58°F
pH = 6.9, 7.0
Cond = 800, 800

30 bails = ~10 gal

---

(111)

IANG-1-MW-8

DTW = 22.69'
Depth to well bottom = 30.45
Depth to top screen = 20.00

Temp = 58°F, 59°F
pH = 6.9, 6.9
Cond = 800, 900

30 bails = ~10 gal

1445 Jerry Stephan from Siouxland Engineering arrived on Base to recon sites 1 + 2 for survey. We walked site 1 and site 2. Talked to Capt. Prescott about maps of the sites and bench marks on the Base.

1730 Jerry Stephan left site. I helped Pat McDonnell pack samples in coolers and take water + soil samples of the defueling pit.

1830 We will ship samples tomorrow. Cleaned up Alert Hangar office and took equip to ship Fed-Ex back to Cleveland. Left site.

T. Benson 8/15/90

---

IANG 8/16/90

Weather: 80s °F, sunny

0800 Pat McDonnell + I delivered samples to Fed. Ex. office and also shipped equip to Clev. office.

1100 Flew out of Sioux City.

T. Benson 8-16-90

TANG 8/21/90

Weather: 70's F, cloudy

0800 K. Palombo, T. Benson arrived @ site 1. Picked up Hermit Pressure Transducer Data Logger, and other equipment that was Fed-Ex'd to Capt. Prescott's office.

Went to Alert Hangar and set up Hermit computer for site 2.

1000 Took water/product levels in wells @ Site 1.

| TIME | WELL | DTF | DTW | Prod Thck |
|---|---|---|---|---|
| 10:27 | MW-2 | 25.00 | 25.00 | 0 |
| 1032 | MW-7 | 24.41 | 24.41 | 0 |
| 1038 | MW-5 | 24.56 | 24.56 | 0 |
| 1040 | MW-8 | 22.68 | 22.68 | 0 |
| 1045 | MW-6 | 22.87 | 22.87 | 0 |
| 1050 | MW-3 | 22.25 | | |

1100 Moved to Site 2 to get water levels and perform aquifer testing with Hermit.

(116)

Site 2

| Well | DTW (from top of casing) |
|---|---|
| MW-1 | ~26.02 |
| MW-2 | 25.88 (top of casing @ grade, not high stick-up casing) |
| MW-3 | 25.36 |
| MW-4 | 25.52 |
| MW-5 | 25.84 |

1115 Set up Hermit for aquifer testing and began performing slug tests on monitor wells.

1630 Finished aquifer testing at site 2, called for gates to be unlocked.

1700 Left site 1 Alert Hangar for the day. T. Benson 8/20/90

---

TANG 8/20/90 (117)

Weather: 70's F, cloudy, drizzle

0800 K. Palombo, T. Benson arrived @ site 1. Drillers on site cleaning up decon pad and getting ready to remove temporary wells at site 2.

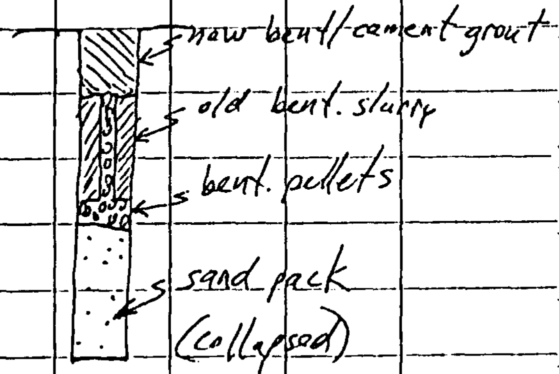
0900 KMP + TAB setting up for Hermit aquifer testing at site 1. Drillers waiting on rain.

1000 Drillers move out to site 2 to begin removing

temporary wells.

Removal procedure:

- pull 2" pvc temporary well with drilling rig cable winch
- measure depth to top of sand pack (collapsed)
- add bentonite pellets up to top of old bentonite slurry
- add new bentonite/cement grout to surface



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1100 KMP & TAB running aquifer test on Site 1 MW-2, 5, 6, 7, 8

1330 Finished aquifer testing. Packed up Hermit & equipment for Fed. Ex.

1400 Went to Fed. Ex. to ship Hermit & equip to Sinking Springs, PA. for different project.

1530 Took KMP to airport. KMP flew out @ 1600.

1700 Labeled barrels of development/purge water. Left for day.
TAB 9/21/10

IANG 8/23/90

Weather: 70°sF, cloudy

0700 Drillers on site,
I arrived, talked to drillers
about drumming soil @
Site 2.

0800 Drillers moved out
to Site 2 to start
drumming soil. I decided
to drum soil @ Site 2 based
on verbal results from CEP
lab doing alpha/beta and
radium analyses. Verbal
results indicated some
alpha/beta in soils. Radium
results are not ready at

this time.

0930 I faxed development
and purge data to K. Palombo,
ES-Clev.

1000 Took field blank
samples of DIUF water
used in decontaminating
bailers, IANG-1-FB-2 (DIUF).
Also got sample of fresh
product (JP-4 fuel) and
old product from IANG-1-MW-4.
Sent to ES lab, Berkeley, CA.
Cleaned up office area.

1400 Took samples to

Fed. Ex. and shipped out. Also shipped DIUF water + methanol back to ES - Cleve.

JP-4 samples needed to be re-packaged in 2 - 16 oz. jars instead of 2 - 1 liter ambers half-full. I took them back to Base and re-packed. Also packed all extra sample bottles + jars not used and prepped them for shipment to ES lab.

2030 Got everything ready for t'morrow morn. to ship out then fly out.

T. Benson 5/22/90

---

TANG 5/24/90

Weather: 70°F, p. cloudy

0700 Met drillers at site 1. They are almost ready to leave site. They finished drumming site 2 soil cuttings and brought drums to site 1 where Capt. Prescott indicated he wanted the drums stored. I labeled all drums. 5/23/90

Drillers took wooden frames off three well + piezometer pads while I went to Site 2 to check things over

(134)

and take pictures.

0830 Drillers left site. I stamped well and piezometer #s on IANG-1-MW-1 through MW-8 and P-1,2,3. Loaded up equipment and product samples to Fed. EX. out

0845 Left for Fed. EX. office

0900 Arrived Fed. EX and shipped everything out.

0945 Arrived back at Alert Hangar to load up the rest of equip. + extra bottles. Called Capt. Prescott, but not in. Called ES-Cleve. talked to KMP.

(135)

1010 Left for Fed. EX. and shipped everything out.

1030 Left Fed. EX. for airport.

1045 Arrived at airport and returned rental (Budget) car.

1100 Boarded flight for CLEVELAND, OHIO

T. Benson 8/24/90

IANG

Radiation Survey Book

Notes

1

IANGB 7/17/90

WEATHER 85° 14:30

FIELD TEAM GS { K.M Palombo
J.L. HANSEN

Prepare to conduct Radiation survey accross Site 2. Base Munitions office has provided personnel to open and close gates for us. We are not permitted to come and go on our own.

J.

DISCUSSED Health & Safety Issues Potential Hazards as discussed on page 6-6 of Health and Safety plan

CALIBRATE INSTRUMENT

Eberline "E 120" INSTRUMENT

SERIAL No. 13450 ← MODEL No.

CALIBRATED WITH a Source

Check. Cesium 137 "CS-7A"

GEN. AREA READINGS AT 3' ABOVE GROUND.

* Instrument calibrated at

Factory on 6-19-90

Calibration is good until

9-1990

BACKGROUND - HP270 probe - .02 MR/Hr.

Began survey : with ~~80 foot~~ KP 9-17-90

~~radius~~, 8 points - 20 ft from fence

all readings Background

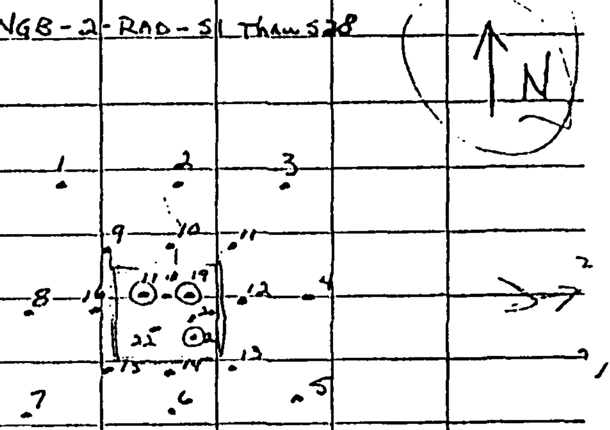
CONTINUED SURVEY : 8 PTS. equidistant

around the FENCE. ALL READINGS

background.

Survey Numbering system

IANGB-2-RAD-S1 Thru S28



S22-28 same positions as S17-22 respectively
↑ Just a probe change

O - indicates casing lids

All survey Readings - Background

Note:

HP270 probe and HP210 probe

Readings taken at the same

positions inside the fence.

Continued survey inside the
fence - 3 pts on contact with the
lids of the casings. All Background.
3 general area pts. - All Background!

Changed Probe to HP-210 (Higher
sensitivity) and performed source
check - satisfactory.
Background : 50 cpm
Monitored 6 points inside fence.
All contact points, 3 on casing
Lids & 3 on the soil.
All Readings Background.

Marked Tentative Well locations
using stakes (wooden) + Flagging tape
Left site 2 at 16:00
Kevin M Palombo

IANG

Field Equipment Book

Notes

IANG 7/25/90

weather: 70s °F, partly

sunny, breezy

Photovac

Gas Chromatograph (GC)

calibrate GC by the

following method:

fill internal gas reservoir

with zero ~~gas~~ air carrier gas

PAS 7/25/90

and set up standard of

o,p xylene, benzene,

toluene (BTX), calibrate

GC to a 1ppm BTX

standard (taken from

soil gas survey field book

7-17-90)

Radiation Detector

Eberline E-120/HP-270

Serial No. 13450

Source Eberline MP-1 S/N 123

Cs-137/S/N EI-123

Cs-137 S/N EI-153

- calibrated with a source check in field
- calibrated @ factory on 6-19-90 and is good through 9-1990

(taken from Rad. survey field notes 7-17-90)

Magnetometer

GeoMetrics G 826

Magnetometer

Factory calibrated, batteries good

Field calibrated to 56000 kilogammas based on illustration and instructions in manual.

(taken from Mag. survey field notes 7-18-90)

Photovac Microtip PID

Hand held Air Monitor/
Photoionization Detector
MP-100
Serial No. NA890138
Specialty Gas Mixture:
100 ppm Isobutylene
Lot 31030

- Calibrated with
ambient air for zero
gas and 100 ppm
isobutylene for span
gas. ~~(taken from~~ TAB 7/25/90

Combustible Gas Indicator

Bacharach
Sniffer Model L
Part No. 23-7271
Serial No. UB0517

- factory calibrated
with hexane

- field calibrate zero
to ambient air

Water Level Indicator

Well Wizard

Model 6000

Serial No. 10599

calibration field checked
ms 7/25/90
– ~~field calibrated~~ on

25' survey rod

IANG

[illegible] Survy Book

Notes

IANGB 7-17-90 ~~7-16-90~~ DSF 1

WEATHER 80° F sunny

0815 Arrive @ site w/ field team

K Palombo, T Benson

J. Henson S. Fiore

0900 Start to set up

GC equipment - fill

internal gas reservoir with

zero DR 7-20-90 [illegible] carrier gas and

setup standard of

o,p xylene, benzene, toluene

(BTX)

0930 - GC equipment set

up and standard

made. Will start

to calibrate equipment

now. Calibration using

1ppm BTX std prepared

earlier.

0940 INJECT STD. INTO GC
INSTRUMENT will not
calibrate correctly,
internal flows are probably
out of spec. Need to
fix. Start to change flows

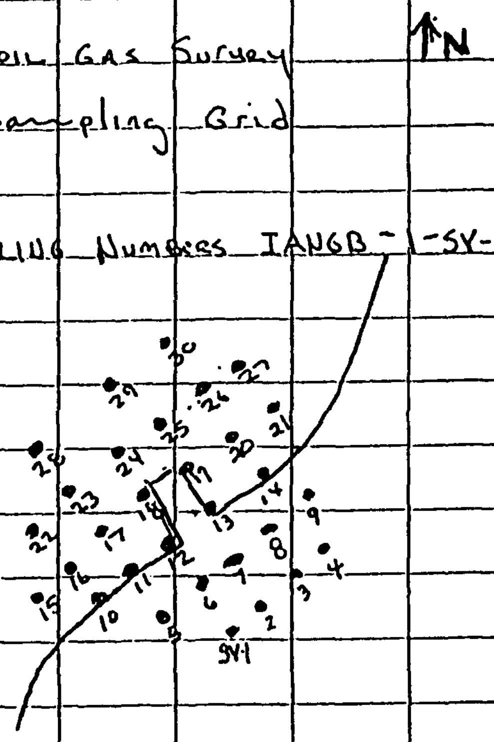
1020 Call Lee Munnes for
advise on above
mentioned problem.
It gave correct flow
rates for each change
of GC.

1350 Cal. GC again w/ BTX ST
still not able to
Calibrate GC correctly

17 July 1990

Soil Gas Survey
Sampling Grid

SAMPLING NUMBERS IANGB - 1-SY-1 → SY-30



1130 WENT TO LUNCH & TO BUY chromatogram paper for GC rtn generator etc.

1300 RTN TO BASE MEET W. CAPT G. PRESCOTT ABOUT Flightline passes & security access

1430 RTN TO 241 and call Pascal La Fantana of Photovac Inc to obtain further technical instruction. Instructions recieved. Septum was loose and needed replacement did same.

1500 GC up and running after calibrating air-flow in series and in parallel.

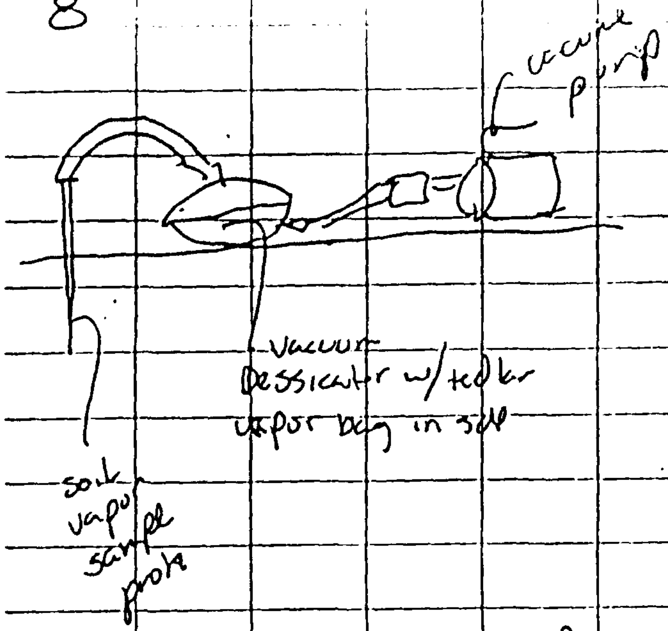
1530 Calibrate GC to a 1 ppm STD BTX and decon all sampling probes using following procedure.

- wipe all dirt off
- clean sample port tips
- clean for min 2 min with aircompressor
- run periodic blanks

1540 start to collect SV samples using train shown on page 8

6 All in PPM 7

| Sample<br>1AN6B-1- | B<br>PPM | T<br>PPM | o xylene<br>PPM | p-xylene<br>PPM | ~~[illegible]~~ 3V<br>Volume<br>uL | Wait | # | TIME | Depth<br>feet | Comments | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STD | .865 | 1.00 | 1.00 | 1.00 | 250 ~~10~~ | 10 | 1 | 15:20 ~~1234~~ SF | — | | |
| decon blank | ND<br>0.0 | ND<br>0.0 | ND<br>0.0 | ND<br>0.0 | 250 | 10 | 2 | 15:40 ~~12:50~~ SF | — | | |
| SV1 | .1375 | .431 | .519 | .211 | 250 | 10 | 3 | 15:55 | 2' | M-xylene also present<br>[illegible] | |
| SV1 | ND | .114 | .49 | ND | 250 | 10 | 4 | 1616 | 4' | " | 2nd xylene not xylene |
| SV2 | ND | .1515 | .186 | ~~.04~~8 | 250 | 10 | 5 | 1635 | 2' | " | |
| SV3 | .032 | .352 | .528 | .187 | 250 | 10 | 6 | 1648 | 2' | " | |
| Needle Blank | ND | ND | — | — | 250 | 10 | 7 | 1700 | — | — | |



sampling protocal

- Drill hole through concrete/asphalt if needed
- Drive slam bar to depth - 6inch
- insert deconned probe into hole
- Drive probe 5ft to depth using hammer
- connect vacuum pump to probe and evacuate hole for min 1 minute
- attach sampling train to to probe
- collect sample / IN TEDLAR BAG ~~carbo bags~~ ZC 7-12-9
- run soil vapor sample on GC -

1550 sample SV1-2' collected from a depth of 2 feet

1555 sample SV1-4' collected from a depth of 4 feet water may be at depth in hole RUN SV1-2' sample
BTX present

1610 Decon needle by using zero Air. decon equip by previously mentioned protocol

1616 run SVS 4' sample
BTX present. 250ul 10gain
1618 6' sample not possible probe wet
1620 will take 2' SVS survey
as it exhibits highest
BTX reading

1630 Collect SVS 2 @ 2'

1635 Run SVS 2-2' on GC
using deconned needle. Inject
250ul @ 10gain.
1640 Collect SVS 3 @ 3'

1645 decon SVS equipment
train by methods
described on page 5

1648 decon needle and run
SVS 3 @ 2' on GC
inject 250ul @ 10 gain
BTX detected
~~1658~~ SSP 1700 needle blank injected
Rerun 250 / 10 gain

1710

Clean up GC equip
1715 leave site for day

SSP

IANGB 7-18-90
CC390.04

0755 ON SITE AT SIOUX GATEWAY AIRPORT MAINTENANCE GARAGE w/ FIELD CREW T. Benson, K Palombo, S. Fiore, S. Hansen to obtain Airport License
No one in bldg.

0805 Proceed to Capt. Gary Prescot office to ascertain course of action for above.

0815 K. Palombo & T. Benson remain at G. Prescots office while S. Fiore & J Hansen proceed to 241 to warm up and set-up GC equipment

0820 prepare standard of 1ppm B ~~TX~~ 7-18 SSF benzene, toluene, o, p-xylene (BTX)

0850 run column Blank as last procedure to warm up GC. and decon all SS sampling probes by methods given on pg 5.

14

## TABLE OF CONCENTRATIONS IN SOIL GAS

| SAMPLE | DEPTH (Feet) | TIME | VOLUME (uL) | OAN | Benzene ppm | Toluene ppm | o-xylene ppm | p-xylene ppm | # | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| Column Blk | – | 8:50 | – | 2 | ND | ND | ND | ND | 1 | — |
| STD 1 | – | 900 | 250 | 2 | ABORT | | | | 2 | |
| STD 2 | – | 902 | 250 | 10 | 1.00 | 1.00 | 1.00 | 1.00 | 3 | M-xylene present |
| SV-4 | 2ft | 930 | 250 | 10 | ND | .239 | .381 | 1.074 | 4 | m xylene " |
| needle blk<br>~~SV-5~~ | — | 1000 | 250 | 2 | ND | ND | ND | .316 | 5 | |
| Needle Blk | – | 1010 | 250 | 2 | ND | ND | ND | ND | 6 | — |
| SV-5 | 2ft | 1024 | 250 | 2 | ABORT | | | | 7 | |
| SV-5 | 2ft | 1026 | 250 | 10 | .046 | .3216 | .604 | .597 | 8 | — |
| SV-6 | 2ft | 1043 | 250 | 10 | .197 | .290 | .569 | .563 | 9 | m xylene present |
| SV-7 | 2ft | 1100 | 250 | 10 | ND | .798 | 1.275 | 1.870 | 10 | " |
| SV-8 | 2ft | 1117 | 250 | 10 | .182 | .565 | .706 | .821 | 11 | " |
| Decon blk | – | 1130 | 250 | 10 | ND | ND | ND | .033 | 12 | — |
| SV-9 | 2ft | 1140 | 250 | 10 | ND | .220 | .479 | .431 | 13 | – |
| SV-10 | 2ft | 1150 | 250 | 10 | .050 | .554 | .857 | 1.221 | 14 | – |
| SV-11 | 2ft | 1210 | 250 | 10 | .099 | .512 | .455 | .527 | 15 | - |

0900 INJECT 250 ul BTX
STD @ 2 gain

0902 Abort above run and
re inject 250 ul BTX STD
@ gain of 10

0915 Calibrate GC to STD and
begin to collect samples

0925 collect sample SVS-4
using equipment train and
sampling protocol listed on
page 8 from @ 4'

0930 inject SVS-4
Decon needle by
using Zero air

0935 Collect SV-5
using train and equip
protocol on page 8 @ 2'

0945 GC turns off needs
AC to function properly
connect to ~~plug~~ SAF extension
cord in outlet.

0958 allow GC to re warm up
after reestablishing power

1000 inject 250 ul needle STD
blank to document decon
procedure

1005 Collect SV-6 from
2 feet

1010 re inject deconned needle blank
after acertaining contamination
of p-xylene still exist.
needle is clean

1015 collect SV-7 using
equipment train and protocol
shown on Page 8

1024 INJECT SV-5 into
GC / Abort reset
SSF 7-18-9
gain to ~~10~~. 10.

1025 Re inject SV-~~5~~ 250ul
@ gain of 10

1030 Decon SS Sampling Probe
by methods given on
page 5.

1040 INJECT 250ul @ 10 gain
of SV-6 into GC.
decon needle w/air
7-18-90
SSF

1045 collect SV8, 9, 10, ~~11~~
using train and protocol
on page 8.
SSF 7/18/90
Gel battery pack ~~[illegible]~~
loses power - Plug into
charger

1100 INJECT SV-7 250ul
at gain of 10 into GC.
decon needle using zero air

1110 decon SS probes and
train using protocol
listed on page 5

1117 INJECT SV-8 250ul
at gain of 10 into G-C
DECON Needle

1130 inject sample train
decon blank 250 ul
at gain of 10 into G-C

1140 inject SV-9 10 gain
250 ul into GC
Decon needle

1150 inject SV-10 at 10 gain
250 ul into GC
decon needle.

1200 Collect SV-11 and
SV-12 using protocol

listed on page 8 - then
deconned same by protocol
listed on page 5. Diesel or keran
~~smell~~ odor detected on SV-12 Probe

1210 INJECT 250ul at 10
gain of SV-11 into
GC Decon needle using
zero air

1220 INJECT 250ul at 10
gain of SV-12 into
GC Decon Needle using
ZERO AIR

1230 Break for lunch

1330 rtn to site from lunch

22

1335 restart GC and recalibrate unit. inject 250 ul of 1 ppm BTX STD @ gain of ~~10~~ to calibrate.

1345 Abort reinject w gain of 10. Collect SV 14 and SV-15 w/sample train on page 8.

1415 inject SV-13 250 ul @ gain of 10

1426 ~~1440~~ SEF-7146 Decon equipment inject SV-14 250 ul @ gain of 10 Decon needle

1446 inject needle blank 250 ul @ gain of 10

23

1455 INJECT SV-15 250ul @ gain of 10 Decon needle Zero Air

1510 INJECT SV-16 250 ul @ gain 10 Decon needle using Zero Air.

1515 Collect SV-17 from 2' using deconned SS probe and equipment train listed on page 8

1527 INJECT SV-17 250ul @ gain 10 Decon needle using Zero air

24 25

| SAMPLE | DEPTH (ft) | TIME | VOLUME (ul) | GAIN | BENZENE PPM | TOLUENE PPM | O-XYLENE PPM | P-XYLENE PPM | # | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| BTXSTD | — | 1335 | 250 | 2 | A | B O | R | T | 17 | GAIN AT 2 |
| BTXSTD | — | 1345 | 250 | 10 | .988 | .986 | .987 | .322 | 18 | |
| SV-13 | 2 | 1415 | 250 | 10 | .405 | 1.710 | .122 | ND | 19 | |
| SV-14 | 2 | 1426 | 250 | 10 | .028 | .386 | .698 | .595 | 20 | m xylene also |
| needle blank | — | 1440 | 250 | 10 | ND | ND | ND | ND | 21 | |
| SV-15 | 2 | 1455 | 250 | 10 | .052 | .412 | .586 | .405 | 22 | |
| SV-16 | 2 | 1520 | 250 | 10 | ND | .039 | .336 | .451 | 23 | m xylene also |
| SV-17 | 2 | 1535 | 250 | 10 | .139 | .444 | .627 | .446 | 24 | |
| SV-19 | 2 | 1600 | 250 | 10 | .034 | .476 | .718 | .762 | 25 | " |
| SV 18 | 2 | 1640 | 250 | 10 | .093 | .693 | .874 | .994 | 26 | |
| Dewar Blank | 2 | 1648 | 250 | 10 | ND | ND | .029 | ND | 27 | " |
| " | 2 | 1700 | 250 | 10 | ND | ND | ND | ND | 28 | " |
| SV20 | 2 | 1715 | 250 | 10 | .047 | .642 | .647 | ND | 29 | " |
| Cal BTX | — | 1740 | ~~250~~ | 10 | 1.053 | .946 | .327 | .750 | 30 | " |

26

1530 collect SV-18 from 2' using deconned sample train as per page 5, 8

1545 INJECT SV-18 250ul gain 10

Decon needle with zero air

1600 Collect SV-19 using deconned sampling train as per page 5, 8

1645 INJECT 250ul @ gain of 10 of SV-19

Decon needle w/zero air

1640 decon equipment train inject decon blank. 250ul @ 10 gain

27

1700 re-inject decon blank after observing that concentration of xylenes were present in the first decon blank. 250ul @ gain of 10

1712 collect sample SV-20 using techniques listed on pages 8 and 5

1715 inject SV-20 250ul 10 gain Decon needle with zero air.

1730 pack up & cleanup done for day.

IANGB 7/11/90

ca30.00 - 75° rainy

0810 arrive on site proceed to bldg 241

0820 set up GC and turn on to calibrate after filling reservoir w/ zero air. Decon probes and sample train as per pg.

0830 prepare 1ppm BTX standard run column blank - Decon needle with zero air

858 INJECT 250ul BTX STD AT GAIN OF 10 decon needle w/ zero air

DECON Procedures

1 SAMPLE TRAIN
AFTER EACH SAMPLE, COMPRESSED AIR WILL BE BLOWN THROUGH ENTIRE SYSTEM TO VOLATILIZE ANY RESIDUAL VOCS DECON BLANKS WILL DOC.

2 INJECTION NEEDLE
AFTER EACH INJECTION NEEDLES WILL BE DECONNED USING ZERO AIR TO VOC. ~~ANY~~ VOCS

3 Probes
as per pages.

IANGB 7/11/90

cu30.ou - 75° rainy

0810 arrive on site proceed to
bldg 241

0820 set up GC and turn
on to calibrate after
filling reservoir w/ zero
air. Decon probes and
sample train as per pg.

0830 prepare 1ppm BTX
standard run column
blank - Decon needle
with zero air

858 INJECT 250ul BTX STD
AT GAIN OF 10 decon
needle w/ zero air

DECON Procedures

1 SAMPLE TRAIN
AFTER EACH SAMPLE,
COMPRESSED AIR WILL BE
BLOWN THROUGH ENTIRE
SYSTEM TO VOLATILIZE
ANY RESIDUAL VOCS
DECON BLANKS WILL DOC.

2 INJECTION NEEDLE
AFTER EACH INJECTION
NEEDLES WILL BE
DECONNED USING ZERO AIR
TO VOC. ~~ANY~~ VOCS

3 Probes
as per pages.

| SAMPLE | DEPTH ft | Time | Vol ul | gain | Benzene PPM | Toluene PPM | o-xylene PPM | p-xylene PPM | # | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| Column Blk | — | 858 | — | 2 | ND | ND | ND | ND | 1 | — |
| BTXSTD | - | 9.11 | 250 | 10 | 1.00 | 1.00 | 1.00 | 1.00 | 2 | |
| DECON/ NEEDLE BLK | — | 920 | 250 | 10 | ABORT | | | | 3 | |
| Decon 2 | - | 932 | 250 | 10 | ND | ND | ND | ND | 4 | |
| SV-21 | 2ft | 944 | 250 | 10 | 1.257 | 1.445 | 1.029 | .172 | 5 | |
| SV-22 | 2ft | 1001 | 250 | 10 | .037 | .520 | 1.420 | .491 | 6 | |
| SV-23 | 2ft | 1015 | 250 | 10 | .465 | .881 | .898 | .221 | 7 | — |
| SV-24 | 2ft | 1028 | 250 | 10 | ND | .572 | 1.245 | .423 | 8 | - |
| Decon Blk | — | 1044 | 250 | 10 | ND | ND | ND | ND | 9 | |
| SV-25 | 2ft | 1058 | 250 | 10 | .302 | .796 | 1.370 | .504 | 10 | |
| SV-26 | 2ft | 11.11 | 250 | 10 | .776 | 1.278 | 1.357 | .356 | 11 | |
| SV-27 | 2ft | 11.26 | 250 | 10 | .232 | .468 | .820 | .158 | 12 | |
| Needle Blk | — | 1145 | 250 | 0 | ND | ND | ND | ND | 13 | |
| SV 28 | 2ft | 1157 | 250 | 10 | .251 | .707 | 1.714 | .648 | 14 | |
| SV 29 | 2ft | 1209 | 250 | 10 | .189 | .426 | .991 | ND | 15 | |
| SV 30 | 2ft | 1402 | 250 | 10 | .057 | ND | [illegible] | .307 | 16 | |

0920 INJECT 250 ul
DECON BLANK TO
CHECK DECON PROCEDURES
ABORT -- REDECON ~~Syst~~

925 REINJECT 250ul Decon
blank - collect SV-21 using
sampling protocol on page 8

935 INJECT 250 ul of SV-21
at gain of 10 Decon
needle with zero air.
Decon sample train

940 collect sample SV-22
using protocol on page 8

945 INJECT SV-22 250 ul gain 10

950 Collect SV-23 and SV-24
using sample train of
Page 8

1005 INJECT 250ul of
SV-23 @ gain of 10
DECON NEEDLE W
ZERO AIR.

1020 INJECT 250 ul of
SV-24 @ gain of 10
decon needle w/ zero air
collect samples SV-25
SV-26, SV-27 and SV-28
using deconned sample probe
and train listed on page 8

1030 INJECT 250 ul of
Decon blank at gain of
10.

1048 INJECT 250ul @ gain 10
of SV-25, DECON
sampling train and
needle.

11 11 INJECT 250ul @ gain 10
of SU-26 Decon
sampling train and needle

11 20 INJECT 250ul @ gain 10
of SV-27 decon all.
equipment

1130 Collect SV-28, SU29 and
SU 30 using decontaminated
sampling train and needles.

1135 INJECT AEROSOL BLANK
250 ul 10 gain.

1145 INJECT SV-28 250ul
@ a gain of 10. Decon
needle and remaining SV
equipment.

11.57 INJECT SV-29 250
ul at a gain of 10
Decon needle and remaining
SV equipment.

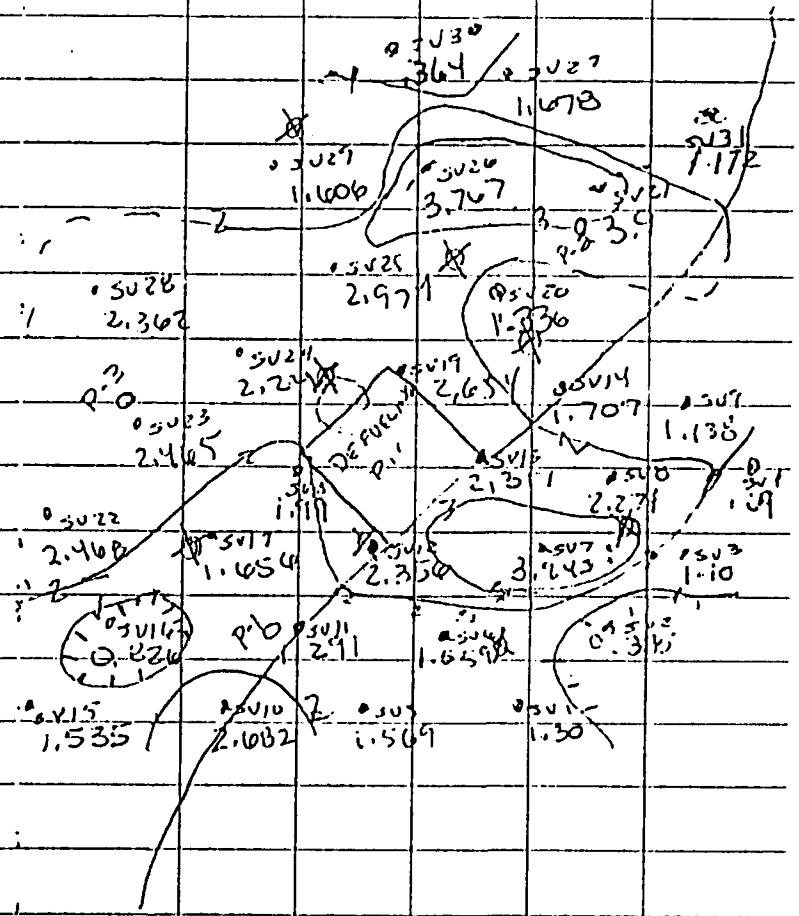
1210 Lunch break

1:45 return from lunch after
talking to Dullus, Cap's Precast

, 50 inject 250ul @ 10 gain
of SU-30 Abort
run Chang gain to 10

151 reinject at gain of 10
250 ul / 30 decon needle
and sample train.

201 collect an additional
soil vapor sample from
an additional point
added to chase a
plume of contaminants
this point is label
IANL65I-SV-31 and
is located 20 away
from SV21



210 INJECT SV31 250ul @
gain of 10. decon needle,
pack equipment

| SAMPLE | Depth ft | TIME | Volum ul | GAIN | Benzene PPM | Toluene PPM | O-xylene PPM | P-xylene PPM | # | cw |
|---|---|---|---|---|---|---|---|---|---|---|
| SV-31 | 2 ft | 1416 | 250 | 10 | ND | ND | 1.099 | ,073 | 17 | |
| BTX STD | – | | 250 | 10 | 1.492 | 1.053 | ND | 2.142 | 18 | |
| | | | | | | | [illegible] | 1.099<br>.073<br>1.172 | | |

300 packup GC and Fed Ex out to Cleveland.

Done w GC.

310 Finish cleaning up GC support equipment.

Shawn S [illegible] 7-19-90

# APPENDIX C

# RECORDS OF PUBLIC WATER WELLS

FORM NO. 78 .- In stock and for sale by Mid-West Prtg. Co., Tulsa W-176

STATE IOWA

SERGEANT BLUFF (WOODBURY)

SE NW NE-SE

Sioux City Airbase #1

SEC. 25

TWP. 88N RGE. 48W

COMMENCED

COMPLETED

CASING RECORD

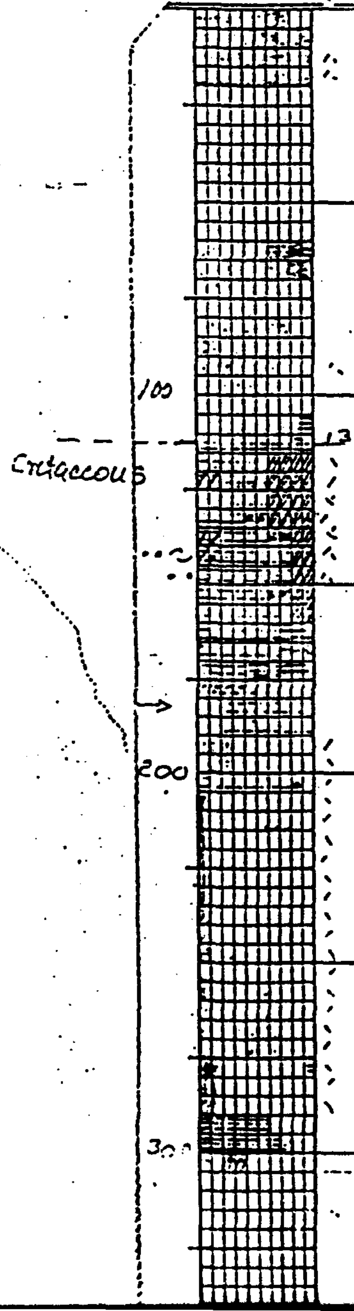
LOGGED October 1943

BY SE Harris Jr.

REMARKS

Elev 1091

T.D. 307



Soil, brn, silt & clay [illegible]

clay, v. silty, v. lt brn mic silty calc

sd. lt. qtz, chl ls (1/2-1/4 60%, 1/4-1/8 30%, 1/8-1/16 5%

much blk, grn, yel, pnk

crser, shell frags abdt

+1 30% 1-1/2 40% 1/2-1/4 30% 1/4-1/8 5% -1/8

sd, v. f-m gr, fos; ls, qtz, ig; clay calc mic

sh, gr, lim nodules

massive

sid pellets drb agglom bot

massive

varieg.

lt gr. [illegible]

May be ss

ss, lt, few grns pnk, yel, fn to med

v. lt, some pnk & yel, A to n some lrger grns

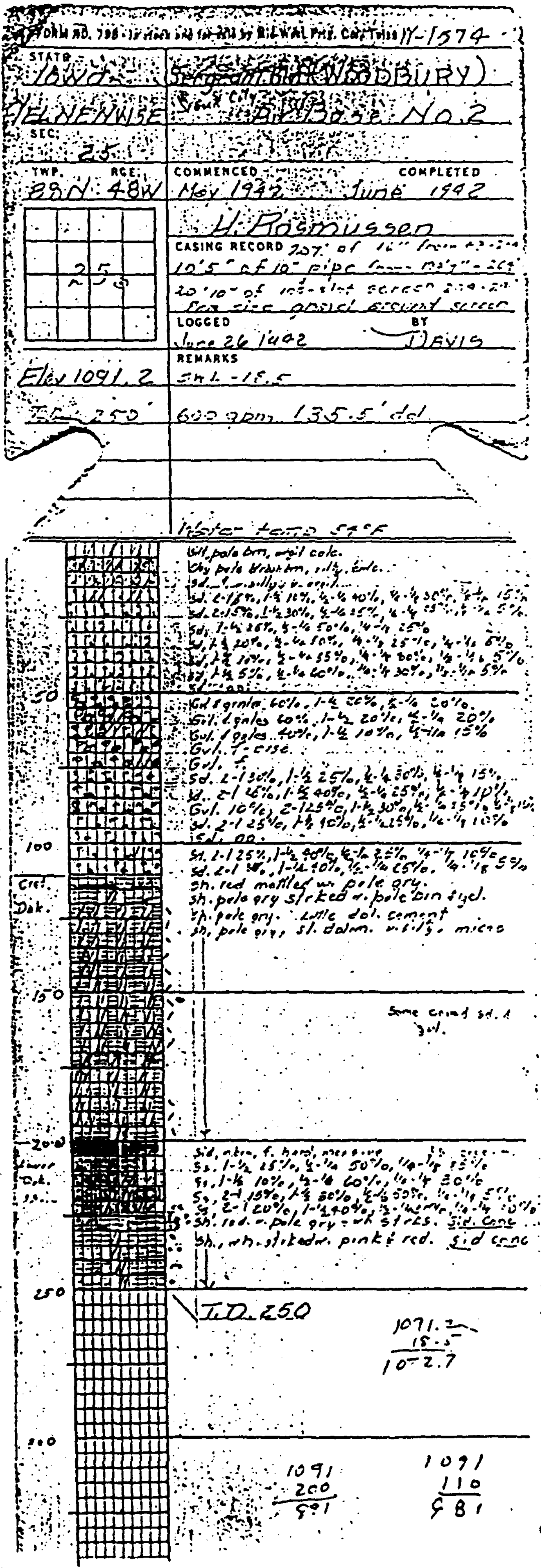
sd. more grns blk, pnk, yel

1091
113
978

C-2

Tom -

These 2 additional logs are in the opposite direction, but they do further characterize the alluvium in the area and the depth to bedrock - at least at these 2 points.



FORM NO. 798 [illegible] W-1574

| | |
|---|---|
| STATE IOWA | (WOODBURY) |
| NE NE NW SE | Sioux City Air Base No. 2 |
| SEC. 25 | |
| TWP. 88N RGE. 48W | COMMENCED May 1942 COMPLETED June 1942 |
| 25 | H. Rasmussen |
| | CASING RECORD 207' of 16" from [illegible] |
| | 10'5" of 10" pipe from [illegible] |
| | 20'10" of 10"-slot screen [illegible] |
| | [illegible] gravel around screen |
| | LOGGED June 26 1942 BY Davis |
| | REMARKS |
| Elev 1091.2 | SWL - 15.5 |
| TD 250' | 600 gpm 135.5' dd |

Water temp 54°F

Sil. pale brn, argil calc.
Cly pale brnish brn, silty, calc.
Sd. [illegible] silty & argil.
Sd. 2-1 15%, 1-½ 10%, ½-¼ 40%, ¼-⅛ 30%, ⅛-1/16 15%
Sd. 2-1 5%, 1-½ 30%, ½-¼ 35%, ¼-⅛ [illegible] 5%.
Sd. 1-½ 26%, ½-¼ 50%, ¼-⅛ 25%
Sd. 1-½ 20%, ½-¼ 50%, ¼-⅛ 25%, ⅛-1/16 5%
Sd. 1-½ 10%, ½-¼ 55%, ¼-⅛ 30%, ⅛-1/16 5%
Sd. 1-½ 5%, ½-¼ 60%, ¼-⅛ 30%, ⅛-1/16 5%
Sd. ao.

50

Sd & grvls 60%, 1-½ 20%, ½-¼ 20%.
Gvl. & grvls 60%, 1-½ 20%, ½-¼ 20%
Gvl. & grvls 40%, 1-½ 10%, ½-¼ 15%
Gvl. f-crse.
Gvl. f.
Sd. 2-1 30%, 1-½ 25%, ½-¼ 30%, ¼-⅛ 15%.
Sd. 2-1 25%, 1-½ 40%, ½-¼ 25%, ¼-⅛ 10%
Gvl. 10%, 2-1 25%, 1-½ 30%, ½-¼ 15% [illegible]
Sd. 2-1 25%, 1-½ 10%, ½-¼ 25%, ¼-⅛ 10%
Sd. ao.

100

Sd. 2-1 25%, 1-½ 40%, ½-¼ 25% ¼-⅛ 10% ⅛-1/16 5%
Sd. 2-1 [illegible], 1-½ 40%, ½-¼ 25%.

→ Cret.

Dak.

sh. red mottled w. pale gry.
sh. pale gry streked w. pale brn & yel.
sh. pale gry. little dol. cement
sh. pale gry, sl. dolom. v. silty, micro

150

Some cemd sd. & gvl.

200

Lower Dak.

Sd, [illegible], f. hard, massive [illegible]
Sd. 1-½ 15%, ½-¼ 50%, ¼-⅛ 35%
Sd. 1-½ 10%, ½-¼ 60%, ¼-⅛ 30%
Sd. 2-1 15%, 1-½ 30%, ½-¼ 50%, ¼-⅛ 5%
Sd. 2-1 20%, 1-½ 40%, ½-¼ [illegible], ¼-⅛ 10%
Sh. red. & pale gry & wh streks. Sid. Conc
Sh. wh. streked w. pink & red. Sid conc

250

T.D. 250

1071.2
15.5
1052.7

300

1091
200
891

1091
110
981

FORM NO. 79—In stock and for sale by Ross-Martin Co., Tulsa. W-30533

| | |
|---|---|
| STATE<br>IOWA | SIOUX CITY (WOODBURY) |
| SW/4 NE SE | IOWA HIGHWAY COMMISSION |
| SEC.<br>6 | WELL #2 - WEST SIDE OF HIGHWAY |
| TWP. 87N RGE. 47W | COMMENCED COMPLETED<br>DEC. 8, 1965 |
| | THORPE WELL CO. |
| | CASING RECORD<br>87' OF 6" CSG. |
| | 10' OF 6" SCREEN |
| EL 20 | LOGGED Nov. 1, 1966 BY NORTHUP |
| EL 1090 FND. | REMARKS<br>WELL IS GRAVEL PACKED |
| TD 97' TOPO | SWL 14' |
| | PL 23' @ 235GPM |
| | DRILLER'S LOG ONLY -<br>NO SAMPLES - WELL IS<br>GRAVEL PACKED |

PLEIS.

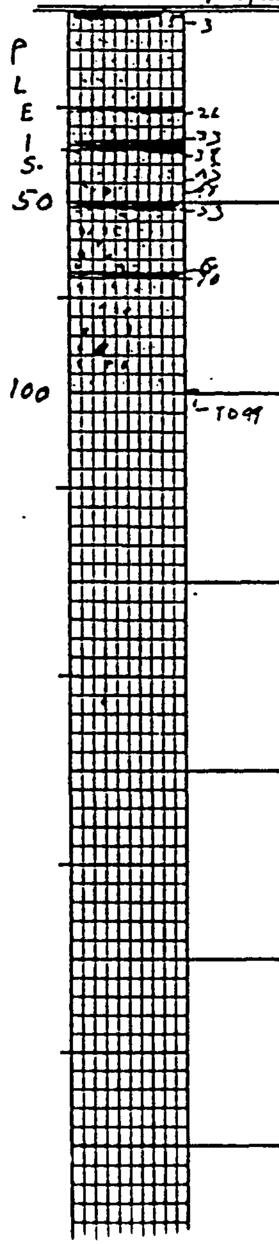
| | |
|---|---|
| 3 | SANDY TOP SOIL |
| | VERY FINE SAND |
| 26 | GRAY CLAY |
| | VERY FINE SAND |
| 33 | GRAY CLAY |
| 38 | FINE SAND |
| 45 | MED. TO COARSE SAND AND GRAVEL |
| 47 | FINE SAND |
| 53 | GRAY CLAY |
| | MEDIUM SAND AND GRAVEL |
| 68 | GRAY CLAY |
| | MEDIUM TO COARSE SAND AND GRAVEL<br>BOULDERS |
| TD 97' | |

50

100

FORM NO. 79—In stock and for sale by Ross-Martin Co., Tulsa. W-30534

| | |
|---|---|
| STATE IOWA | SIOUX CITY (WOODBURY) |
| SW SE SE SE | IOWA HIGHWAY COMMISSION |
| SEC. 6 | WELL M - EAST SIDE OF HIGHWAY |
| TWP. 87N RGE. 47W | COMMENCED COMPLETED NOV. 22-23, 1965 |
| | THORPE WELL CO. |
| | CASING RECORD 89' OF 6" CSG. |
| | 10' OF 6" SCREEN |
| | LOGGED NOV. 1, 1966 BY NORTHUP |
| EL 1090 | REMARKS FHD WELL IS GRAVEL PACKED |
| TD 99' 1: TOPO | SWL 8' |
| | PL 26' @ 290 GPM. |
| | NO SAMPLES - DRILLER'S LOG |
| | COPIED |

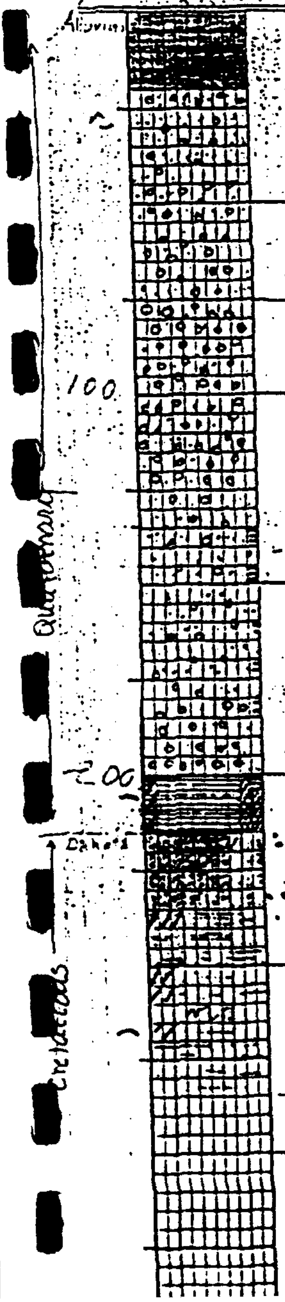


SANDY TOP SOIL
VERY FINE SAND

GRAY CLAY
VERY FINE SAND
GRAY CLAY
FINE SAND
MED. TO COARSE SAND AND GRAVEL
[illegible]
GRAY CLAY
MED. SAND AND GRAVEL
GRAY CLAY
MEDIUM TO COARSE SD. AND GRAVEL
BOULDERS

FORM NO. 798 - In stock and for sale by Mid-West Prtg. Co., Tulsa W-1713

|  |  |
|---|---|
| STATE<br>Iowa | Sargent Bluff (WOODBURY) |
| SW-SE-NE | Sioux City Air Base Test #3 |
| SEC.<br>36 |  |
| TWP. 88 RGE. 48 | COMMENCED — COMPLETED July 1943 |
| 36 | Layne-Western |
|  | CASING RECORD<br>Gravel pack |
|  | LOGGED July 10 1943 BY S.E. Harris Jr. |
| Elev 1090 | REMARKS<br>Rotary |
| T.D. 285 | swl about 16' |
|  | 20 gpm |



clay

Glacial sd & gr, Qtz. sd, pol, some blk, yel, ls, & pbls

Derived from Dakota

gr & some sd, pbls. ls, & qtz, ch

(?1, 22%; 1-½, 30%; ½ ... ; ...) [illegible]

Carbonized wood

sd. qtz, pol, clear, some yel. pnk, Lik
ls & ls. cave
1, 15%; 1-¼, 20%; ½-⅛, 35%; ⅛-1/16, 20%; ... 10%

Sh, varieg. red, wh, gr

brach 1090

→ T D 285'

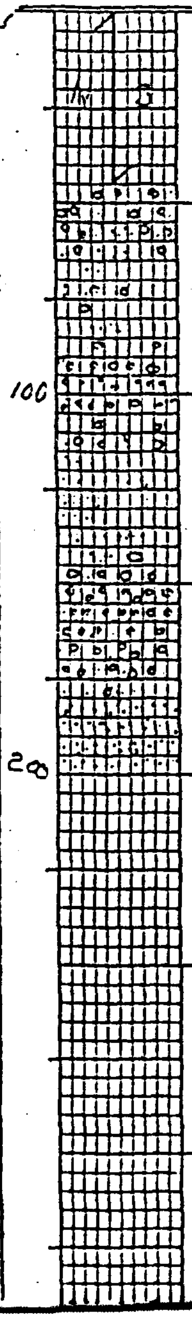
1097 ±
215
[illegible]

1090
16
1074

---

FORM NO. 79 - In stock and for sale by Mid-West Prtg. Co., Tulsa W-1717

|  |  |
|---|---|
| STATE<br>Iowa | SARGENT BLUFF (WOODBERRY) |
| SW-SE-NE | Sioux City AirBase #3 |
| SEC.<br>36 |  |
| TWP. 88 RGE. 48 | COMMENCED — COMPLETED July 1943 |
| 36 | Layne-Western |
|  | CASING RECORD<br>12" casing |
|  | 20' of screen |
|  | LOGGED July 20, 1943 BY S.E. Harris |
| Elev 1090 | REMARKS<br>SWL - 18' |
| T.D. 235 |  |



Note: All sd & gr. sple. v. dirty

Sd derived from Dakota, clear pol ... 
gr., ls, ig, dolo, qtz

Brn. silt masses throughout
sl. ... mostly Dak. ...

crse sd & granules pol qtz, ls, ig

crse to v. crse sd & granules 25% granules

Tom Benson
Engineering Scie
Cleveland, Ohio

C-6

# APPENDIX D

# SOIL-GAS TABLE OF RESULTS

## TABLE 1

## SOIL-GAS TABLE OF RESULTS

| Sample Location | Depth (feet) | Benzene (ppm) | Toluene (ppm) | O-Xylene (ppm) | P-Xylene (ppm) |
|---|---|---|---|---|---|
| SV1 | 2 | .138 | .431 | .519 | .211 |
| SV1 | 4 | ND | .114 | .49 | ND |
| SV2 | 2 | ND | .152 | .186 | .048 |
| SV3 | 2 | .032 | .352 | .528 | .187 |
| SV4 | 2 | ND | .239 | .381 | 1.074 |
| SV5 | 2 | .046 | .322 | .604 | .597 |
| SV6 | 2 | .197 | .290 | .509 | .563 |
| SV7 | 2 | ND | .798 | 1.275 | 1.870 |
| SV8 | 2 | .182 | .565 | .706 | .821 |
| SV9 | 2 | ND | .228 | .479 | .431 |
| SV10 | 2 | .050 | .554 | .857 | 1.221 |
| SV11 | 2 | .099 | .512 | .455 | .522 |
| SV12 | 2 | .118 | .581 | .710 | .947 |
| SV13 | 2 | .485 | 1.710 | .122 | ND |
| SV14 | 2 | .028 | .386 | .698 | .595 |
| SV15 | 2 | .052 | .412 | .586 | .485 |
| SV16 | 2 | ND | .039 | .336 | .451 |
| SV17 | 2 | .139 | .444 | .627 | .446 |
| SV18 | 2 | .034 | .476 | .718 | .762 |
| SV19 | 2 | .013 | .693 | .874 | .994 |
| SV20 | 2 | .047 | .642 | .647 | ND |
| SV21 | 2 | 1.257 | 1.445 | 1.026 | .172 |
| SV22 | 2 | .037 | .520 | 1.420 | .491 |
| SV23 | 2 | .465 | .881 | .898 | .221 |
| SV24 | 2 | ND | .572 | 1.245 | .423 |
| SV25 | 2 | .302 | .796 | 1.372 | .504 |
| SV26 | 2 | .766 | 1.278 | 1.357 | .356 |
| SV27 | 2 | .232 | .468 | .820 | .158 |
| SV28 | 2 | .251 | .767 | 1.714 | .648 |
| SV29 | 2 | .189 | .426 | .991 | ND |
| SV30 | 2 | .057 | ND | ND | .307 |
| SV31 | 2 | ND | ND | 1.099 | .073 |

(1)None detected

# APPENDIX E

# MONITORING WELLS AND SOIL BORING LOGS

| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER P-1 | LOCATION SITE 1 -DEFUELING PIT | |
| | DATE 24 JULY 1990 | WEATHER 70°F , OVERCAST BREEZY | |
| | LOCATED BY KMP/TAB | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

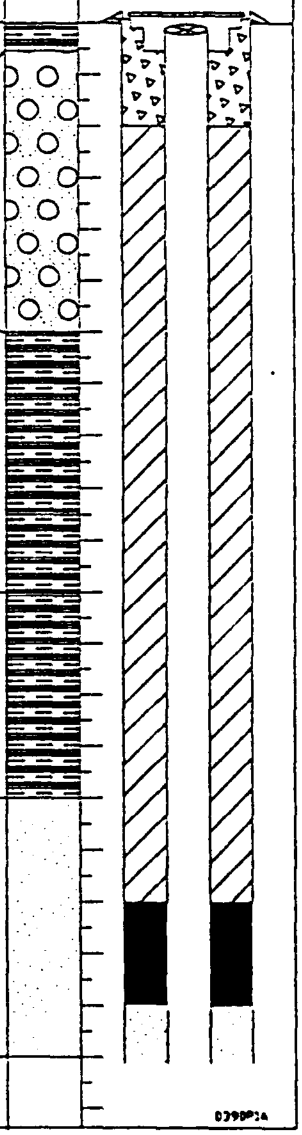
| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH 40 PVC | | DIAMETER 1" | LENGTH 21' | HOLE DIA. 7 1/4" |
| SCREEN TYPE SCH 40 PVC | SLOT 0.010" | DIAMETER 1" | LENGTH 10' | TOTAL DEPTH 31' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 0 | | 2 | DARK BROWN, DAMP, SLIGHT PLASTIC SILT CLAY, NO HYDROCARBON ODOR, (H-C)[ML] |
| S-1 | 0.0 | | | 5 | |
| | | 1 | | 7 | |
| | | | | 9 | BROWN, DAMP, NON-PLASTIC, POORLY SORTED, SILTY SAND AND GRAVEL, NO H-C ODOR [SW]. |
| | | 2 | | 5 | |
| S-2 | 0.0 | | | 5 | |
| | | 3 | | 4 | |
| | | | | 3 | |
| S-3 | 0.0 | 4 | | 3 | SAME AS ABOVE, MOIST, NO H-C ODOR. |
| | | | | 3 | |
| | | 5 | | 2 | |
| | | | | 1 | |
| | | 6 | | 1 | GRAY-BROWN, MOIST, PLASTIC, CLAY, LITTLE SILT, NO H-C ODOR. |
| S-4 | 0.0 | | | 2 | |
| | | 7 | | 3 | |
| | | | | 5 | |
| | | 8 | | 1 | |
| | | | | 2 | |
| S-5 | 0.0 | 9 | | 3 | |
| | | | | 3 | |
| | | 10 | | 1 | |
| | | | | 1 | |
| S-6 | 272 | 11 | | 2 | GRAY WITH DARK GRAY DISCOLORATION, MOIST, MED-HI PLASTICITY, SILTY CLAY, ODOR [CL]. |
| | | | | 3 | |
| | | 12 | | 1 | |
| S-7 | 890 | | | 2 | |
| | | 13 | | 3 | |
| | | | | 3 | |
| | | 14 | | 1 | |
| | | | | 2 | |
| S-8 | 6100 | 15 | | 3 | GRAY, MOIST, NON-PLASTIC, WELL SORTED, FINE-GRAINED SILTY SAND, H-C ODOR. SAME AS ABOVE, MOIST, H-C ODOR, [SM]. |
| | | | | 2 | |
| | | 16 | | 5 | |
| | | | | 12 | |
| S-9 | 6600 | 17 | | 11 | |
| | | | | 14 | |
| | | 18 | | 6 | |
| | | | | 15 | SAME AS ABOVE, MOIST H-C ODOR. |
| S-10 | 3600 | 19 | | 22 | |
| | | | | 25 | |
| | | 20 | | | FINISHED FOR THE DAY @ 20'. |
| | | 21 | | | |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



LOCATION MAP

SEE FIGURE 3.3

ELEVATION

## ENGINEERING-SCIENCE WELL LOG

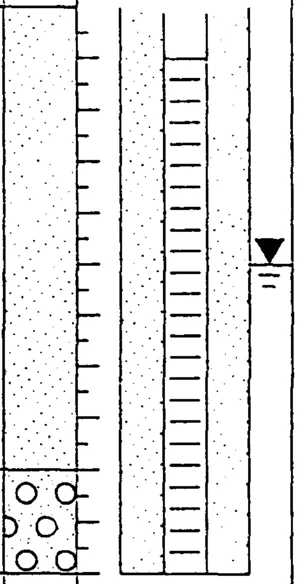
PAGE 2 OF 2

WELL NUMBER P-1 (CONT.)
LOCATION SITE 1 -DEFUELING PIT
DATE 25 JULY 1990
WEATHER 70°F , OVERCAST BREEZY
LOCATED BY KMP/TAB
DRILLED BY FOX DRLG.
DRILLING METHOD HOLLOW-STEM AUGER
SAMPLING METHOD SPLIT-SPOON
GRAVEL PACK SAND (30/70)
SEAL BENTONITE
CASING TYPE SCH 40 PVC DIAMETER 1' LENGTH 21'
HOLE DIA. 7 1/4"
SCREEN TYPE SCH 40 PVC SLOT 0.010" DIAMETER 1' LENGTH 10'
TOTAL DEPTH 31'

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-11 | 6500 | 20–22 | X | 7<br>16<br>22<br>26 | GRAY, MOIST, NON-PLASTIC, WELL SORTED, FINE-GRAINED, SILTY SAND, H-C ODOR [SM].<br>22'-22.5' BROWN SILTY SAND, SAME AS ABOVE. |
| S-12 | 8715 | 22–24 | X | 6<br>8<br>9<br>8 | SAME AS ABOVE, MOIST, H-C ODOR. |
| S-13 | 6720 | 24–26 | X | 3<br>10<br>11<br>11 | SAME AS ABOVE, WET @ 25', H-C ODOR, SHEEN ON WATER INSIDE SPOON SHOE. |
| S-14 | 450 | 26–28 | X | 3<br>6<br>7<br>8 | SAME AS ABOVE, WET, LESS H-C ODOR. |
| S-15 | 2450 | 28–30 | X | 5<br>7<br>8<br>9 | SAME AS ABOVE, WET, H-C ODOR.<br>GRAY, WET, NON-PLASTIC, MEDIUM TO POORLY SORTED, FINE TO COARSE-GRAINED, SILTY SAND WITH SUBROUNDED GRAVEL, H-C ODOR [SW]. |
|  |  | 31–41 |  |  | AUGERED TO 31' AND INSTALLED PIEZOMETER [P-1]. |

LITHO. PROFILE

WELL COMPLETION



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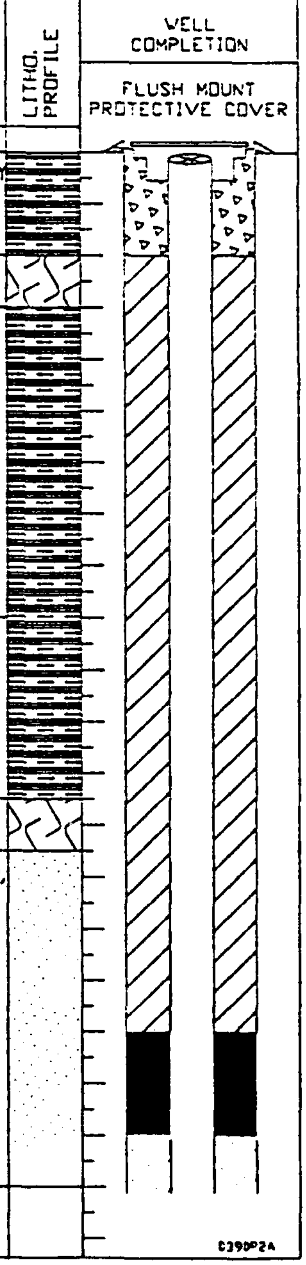
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER P-2 | LOCATION SITE 1 -DEFUELING PIT | |
| | DATE 26 JULY 1990 | WEATHER 65°F, OVERCAST, RAIN | |
| | LOCATED BY KMP/TAB | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 1" | LENGTH 21' | HOLE DIA. 7 1/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 1" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|
| S-1 | 54.3 | 0–2 | 1<br>4<br>7<br>13 | BROWN GRAY, MOIST, MED. PLASTIC, SILTY CLAY WITH ORGANICS, NO HYDROCARBON (H-C) ODOR, [CL]. |
| S-2 | 85.9 | 2–4 | 6<br>7<br>7<br>13 | GRAY, DAMP, NON-PLASTIC, SILT, [ML], NO H-C ODOR.<br>GRAY, DAMP, LOW PLAST. SILTY CLAY, [CL] NO H-C ODOR. |
| S-3 | 16.6 | 4–6 | 6<br>8<br>11<br>13 | |
| S-4 | 14.2 | 6–8 | 3<br>6<br>7<br>7 | SAME AS ABOVE, NO H-C ODOR. |
| S-5 | 4427 | 8–10 | 4<br>6<br>7<br>5 | GRAY WITH GRAY DISCOLORATION, MOIST, LOW-MED. PLAST, SILTY CLAY [CL], H-C ODOR. |
| S-6 | 7810 | 10–12 | 3<br>5<br>7<br>7 | SAME AS ABOVE, MOIST, H-C ODOR. |
| S-7 | 6100 | 12–14 | 3<br>5<br>7<br>10 | GRAY, DAMP TO MOIST, NON-PLASTIC, CLAYEY SILT, [ML], H-C ODOR. |
| S-8 | 6333 | 14–16 | 6<br>13<br>17<br>21 | GRAY, DAMP, NON-PLASTIC, WELL SORTED, (POORLY GRADED), FINE GRAINED SILTY SAND, [SM], H-C ODOR.<br>SAME AS ABOVE, H-C ODOR. |
| S-9 | 6317 | 16–18 | 6<br>16<br>27<br>34 | SAME AS ABOVE, H-C ODOR. |
| S-10 | 7140 | 18–20 | 10<br>14<br>20<br>26 | SAME AS ABOVE, DAMP, H-C ODOR. |
| | | 20–21 | | CONTINUED ON NEXT PAGE. |



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER P-2 (CONT.) | LOCATION SITE 1 -DEFUELING PIT | |
| | DATE 26 JULY 1990 | WEATHER 70°F , OVERCAST BREEZY | |
| | LOCATED BY KMP/TAB | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

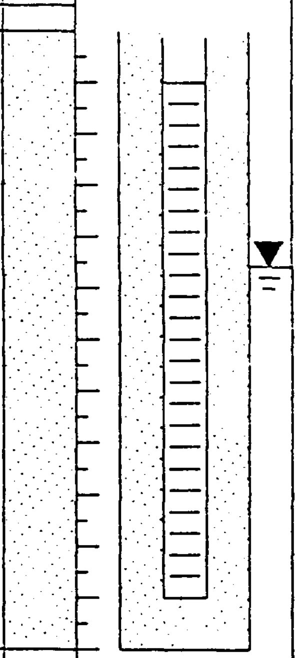
| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH 40 PVC | | DIAMETER 1" | LENGTH 21' | HOLE DIA. 7 1/4" |
| SCREEN TYPE SCH 40 PVC | SLOT 0.010" | DIAMETER 1" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-11 | 6521 | 20–22 | X | 8<br>14<br>16<br>22 | GRAY, DAMP, NON PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED SILTY SAND, [SM], H-C ODOR. |
| S-12 | 6109 | 22–24 | X | 10<br>13<br>16<br>18 | SAME AS ABOVE, MOIST TO WET H-C ODOR. |
| S-13 | 6126 | 24–26 | X | 4<br>3<br>6<br>9 | SAME AS ABOVE, WET @ 24.5' VISIBLE H-C SHEEN ON WATER INSIDE SPOON, H-C ODOR. |
| S-14 | 4910 | 26–28 | X | 4<br>5<br>8<br>13 | SAME AS ABOVE, WET, H-C ODOR. |
| S-15 | 450 | 28–30 | X | 12<br>20<br>16<br>18 | SAME AS ABOVE, WET, H-C ODOR. |
| | | 32 | | | AUGERED TO 32' AND INSTALLED PIEZOMETER P-2. |

DEPTH: 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

LITHO. PROFILE

WELL COMPLETION



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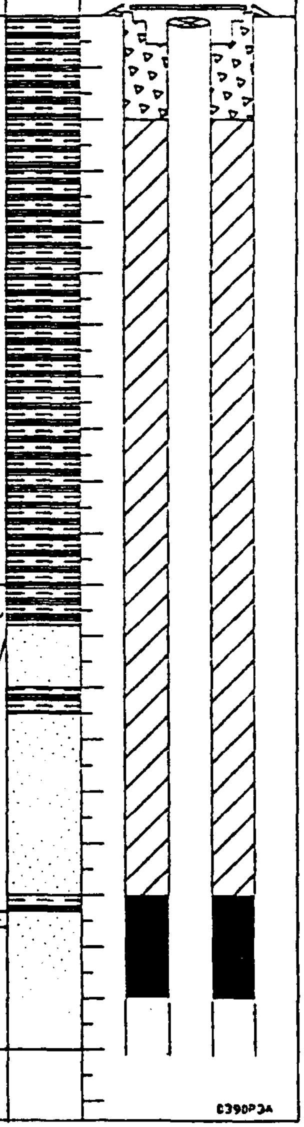
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER P-3 | LOCATION SITE 1 -DEFUELING PIT | |
| | DATE 27 JULY 1990 | WEATHER 70-80°F, PARTLY SUNNY | |
| | LOCATED BY KMP/TAB | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 1' | LENGTH 21' | HOLE DIA. 7 1/4' |
| SCREEN TYPE SCH 40 PVC SLOT 0.010' | DIAMETER 1' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 0 | | | |
| S-1 | 20.2 | 1 | ☒ | 2<br>4<br>7<br>6 | GRAY BROWN, DAMP-MOIST, SLIGHT PLAST, SILTY CLAY, [CL], NO HYDROCARBON (H-C) ODOR. |
| | | 2 | | | |
| S-2 | 40.0 | 3 | ☒ | 5<br>7<br>9<br>9 | SAME AS ABOVE, NO H-C ODOR. |
| | | 4 | | | |
| S-3 | 50.2 | 5 | ☒ | 4<br>6<br>7<br>9 | SAME AS ABOVE, NO H-C ODOR. |
| | | 6 | | | |
| S-4 | 89.9 | 7 | ☒ | 3<br>5<br>8<br>9 | SAME AS ABOVE, NO H-C ODOR. |
| | | 8 | | | |
| S-5 | 42.4 | 9 | ☒ | 3<br>4<br>6<br>8 | SAME AS ABOVE, NO H-C ODOR. |
| | | 10 | | | |
| S-6 | 50.5 | 11 | ☒ | 3<br>4<br>7<br>8 | |
| | | 12 | | | GRAY, MOIST, SLIGHT PLAST, SILTY CLAY, [CL], NO H-C ODOR, GRADING INTO GRAY, MOIST, NON-PLASTIC, WELL SORTED, (POORLY GRADED), SILTY SAND, [SM], NO H-C ODOR. |
| S-7 | 137 | 13 | ☒ | 3<br>2<br>3<br>5 | |
| | | 14 | | | |
| S-8 | 107 | 15 | ☒ | 10<br>13<br>14<br>14 | GRAY SILTY SAND [SM], AS ABOVE WITH LENS (13'-13.5') OF GRAY SILTY CLAY AS ABOVE, NO H-C ODOR IN SAND OR CLAY. |
| | | 16 | | | |
| S-9 | 3337 | 17 | ☒ | 14<br>15<br>19<br>21 | @ 17', DARK GRAY SILTY SAND [SM] SAME AS ABOVE, FINE-GRAINED, H-C ODOR. |
| | | 18 | | | @ 17.25' GRAY SILTY SAND [SM] SAME AS ABOVE, FINE-GRAINED, H-C ODOR. |
| S-10 | 4214 | 19 | ☒ | 15<br>16<br>19<br>29 | |
| | | 20 | | | CONTINUED ON NEXT PAGE. |
| | | 21 | | | |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER

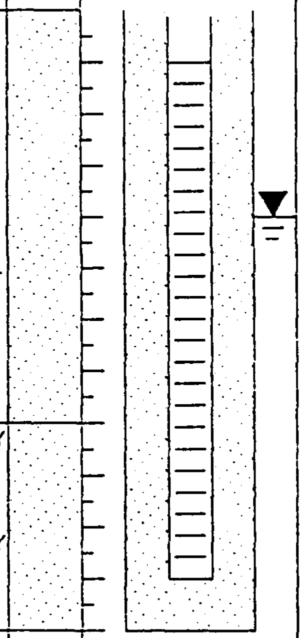


| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER P-3 (CONT.) | LOCATION SITE 1 -DEFUELING PIT | |
| | DATE 27 JULY 1990 | WEATHER 70-80°F | |
| | LOCATED BY KMP/TAB | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 1' | LENGTH 21' | HOLE DIA. 7 1/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 1' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-11 | 3736 | 20-22 | X | 13<br>14<br>19<br>13 | GRAY, MOIST, NON PLASTIC, WELL SORTED (POORLY GRADED), SILTY SAND, [SM], H-C ODOR. |
| S-12 | 733 | 22-24 | X | 6<br>10<br>19<br>22 | SAME AS ABOVE, MOIST TO WET, H-C ODOR. |
| S-13 | 880 | 24-26 | X | 8<br>9<br>14<br>15 | SAME AS ABOVE, WATER @24', H-C ODOR. |
| S-14 | 187 | 26-28 | X | 3<br>3<br>6<br>5 | SAME AS ABOVE, WET, H-C ODOR. |
| S-15 | 161 | 28-30 | X | 3<br>3<br>6<br>9 | BROWN-GRAY, WET, NON-PLASTIC, POORLY SORTED (WELL GRADED), SILTY SAND, [SW], SLIGHT H-C ODOR, SHELL REMAINS 28'-29', PLANT (WOOD) REMAINS @-29.7' IN DARK GRAY TO BLACK ORGANIC SANDY ZONE FROM 29.7'-30'. |
| | | 32 | | | AUGERED FROM 30' TO 32' INSTALLED P-3. |

LITHO. PROFILE

WELL COMPLETION



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| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-1/TW-1 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 27,28 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

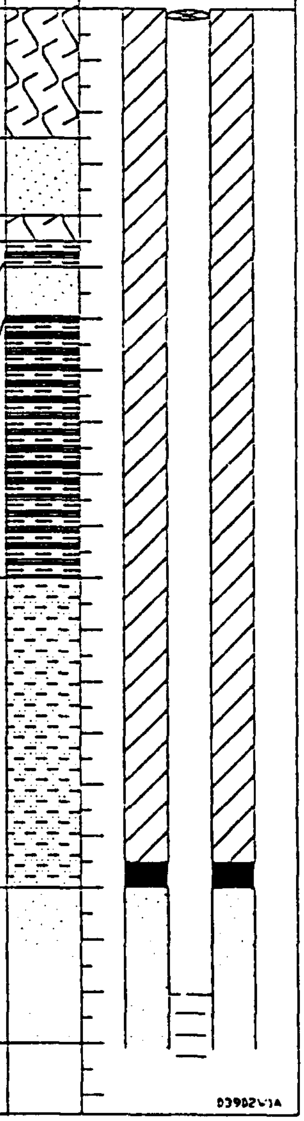
| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH 40 PVC | | DIAMETER 2' | LENGTH 19' | HOLE DIA. 9 3/4' |
| SCREEN TYPE SCH 40 PVC | SLOT 0.010' | DIAMETER 2' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 50-100 | 0 | ☒ | 2 | |
| | | | ☒ | 3 | BROWN, MOIST, LOW PLAST, SILT, [ML], NO ODOR. |
| | | 1 | ☒ | 3 | |
| | | | | 3 | |
| *<br>S-2<br>(S1) | 50-100 | 2 | ☒ | 3 | |
| | | | ☒ | 4 | BROWN, DAMP, NON-PLAST, WELL SORTED (POORLY GRADED) SILTY SAND, [SM], NO ODOR. |
| | | 3 | ☒ | 5 | |
| | | | ☒ | 5 | |
| S-3 | 50-100 | 4 | ☒ | 5 | BROWN, SILT AS EARLIER [ML], NO ODOR. |
| | | | ☒ | 5 | BROWN-GRAY, MOIST, PLAST, SILTY CLAY [CL], NO ODOR. |
| | | 5 | ☒ | 6 | |
| | | | ☒ | 7 | BROWN, DAMP, NON-PLAST, WELL SORTED (POORLY GRADED), SILTY SAND, [SM], NO ODOR. |
| S-4 | 50-100 | 6 | ☒ | 1 | |
| | | | ☒ | 2 | |
| | | 7 | ☒ | 4 | |
| | | | ☒ | 3 | BROWN, MOIST, LOW PLAST, SILTY CLAY, [CL], NO ODOR. |
| *<br>S-5<br>(S2) | 50-100 | 8 | ☒ | 2 | |
| | | | ☒ | 3 | |
| | | 9 | ☒ | 6 | |
| | | | ☒ | 8 | SAME AS ABOVE, MOIST, NO ODOR. |
| S-6 | 50-100 | 10 | ☒ | 2 | |
| | | | ☒ | 5 | |
| | | 11 | ☒ | 8 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY SAND, [SM], NO ODOR, WITH INTERBEDS OF BROWN, MOIST, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| | | | | 9 | |
| S-7 | 50-100 | 12 | ☒ | 3 | |
| | | | ☒ | 3 | |
| | | 13 | ☒ | 4 | |
| | | | | 5 | |
| S-8 | 50-100 | 14 | ☒ | 4 | |
| | | | ☒ | 4 | |
| | | 15 | ☒ | 6 | SAME AS ABOVE, NO ODOR. |
| | | | | 4 | |
| S-9 | 50-100 | 16 | ☒ | 2 | |
| | | | ☒ | 2 | |
| | | 17 | ☒ | 5 | BROWN & GRAY, DAMP, NON-PLASTIC WELL SORTED (POORLY GRADED), SILTY FINE-GRAINED SAND, [SM] SOME CLAY, NO ODOR. |
| | | | ☒ | 5 | |
| S-10 | 50-100 | 18 | ☒ | 2 | |
| | | | ☒ | 3 | |
| | | 19 | ☒ | 5 | |
| | | | ☒ | 6 | SAME AS ABOVE, NO ODOR. |
| | | 20 | | | CONTINUED ON NEXT PAGE. |
| | | | | | |
| | | 21 | | | |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



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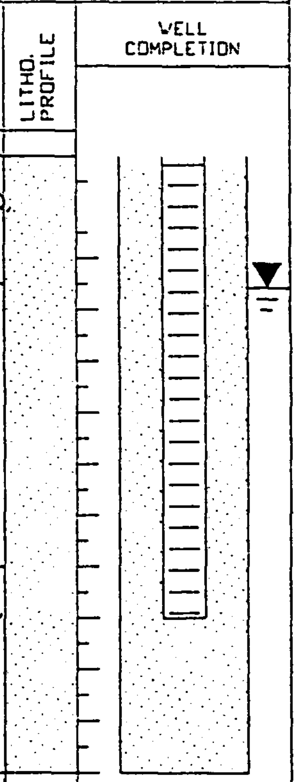
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-1/TW-1 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 28 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 2' | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| * S-11 (S3) | 50-100 | 20<br>21<br>22 | X | 2<br>4<br>5<br>6 | BROWN AND GRAY, DAMP TO MOIST, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| S-12 | 50-100 | 23<br>24 | X | 2<br>1<br>2<br>3 | GRAY, WET, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], LITTLE CLAY, DECAYING ORGAINCS ODOR. WATER TABLE @ 22.5'. |
| S-13 | 50-100 | 25<br>26 | X | 1<br>2<br>1<br>1 | |
| S-14 | 50-100 | 27<br>28 | X | 1<br>3<br>5<br>7 | SAME AS ABOVE, DECAYING WOOD @ 27', DECAYING ORGANICS ODOR. |
| S-15 | 50-100 | 29<br>30 | X | 4<br>6<br>9<br>12 | BROWN, WET, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| | | 31<br>32 | | | AUGERED TO 32' AND INSTALLED TEMPORARY WELL. |
| | | 33<br>34<br>35<br>36<br>37<br>38<br>39<br>40<br>41 | | | * SOIL SAMPLE CHOSEN FOR LAB ANALYSES. |



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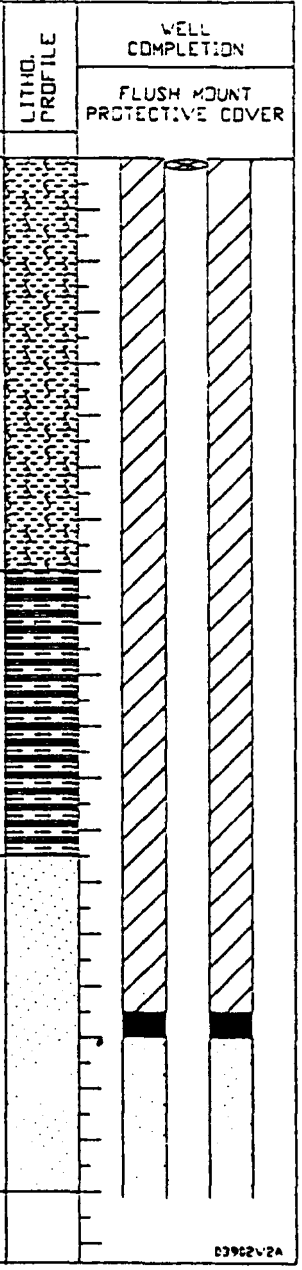
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-2/TW-2 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 28 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 21' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/MINUTE (CPM) | DEPTH | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|
| S-1 | 50-100 | 0-2 | 2<br>2<br>2<br>2 | BROWN, DAMP, NON-PLASTIC, SILT, [ML], NO ODOR. |
| * S-2 (S1) | 50-100 | 2-4 | 3<br>2<br>2<br>3 | BROWN, DRY, NON-PLASTIC, SILT, [ML], (LOESS), NO ODOR. |
| S-3 | 50-100 | 4-6 | 3<br>2<br>2<br>4 | SAME AS ABOVE. |
| S-4 | 50-100 | 6-8 | 3<br>2<br>4<br>4 | SAME AS ABOVE WITH INTERBEDS OF GRAY, DAMP, PLASTIC, SILTY CLAY [CL], NO ODOR. |
| * S-5 (S2) | 50-100 | 8-10 | 3<br>4<br>6<br>7 | GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-6 | 50-100 | 10-12 | 3<br>4<br>7<br>7 | SAME AS ABOVE, NO ODOR. |
| S-7 | 50-100 | 12-14 | 2<br>3<br>5<br>6 | SAME AS ABOVE, NO ODOR. |
| S-8 | 50-100 | 14-16 | 2<br>4<br>4<br>4 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY FINE-GRAINED, SAND, [SM], NO ODOR. |
| S-9 | 50-100 | 16-18 | 3<br>4<br>5<br>5 | SAME AS ABOVE, NO ODOR. |
| S-10 | 50-100 | 18-20 | 4<br>5<br>7<br>7 | SAME AS ABOVE, NO ODOR. |
| | | 20-21 | | CONTINUED ON NEXT PAGE. |



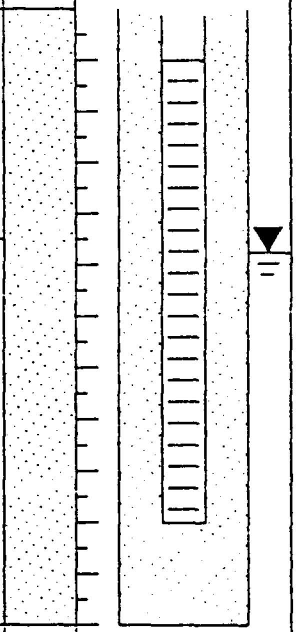
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-2/TW-2 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 28 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | |
|---|---|---|---|
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 21' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 20 | | | |
| S-11 | 50-100 | 21 | X | 5<br>6<br>6<br>6 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED, SAND, [SM], NO ODOR. |
| | | 22 | | | |
| S-12 | 50-100 | 23 | X | 5<br>4<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| | | 24 | | | |
| * S-13 (S3) | 50-100 | 25 | X | 3<br>4<br>6<br>6 | GRAY, WET, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND [SM], DECAYING ORGANICS ODOR. |
| | | 26 | | | |
| S-14 | 50-100 | 27 | X | 2<br>3<br>4<br>4 | |
| | | 28 | | | |
| S-15 | 50-100 | 29 | X | 1<br>2<br>4<br>4 | SAME AS ABOVE, DECAYING ORGANICS ODOR. |
| | | 30 | | | |
| | | 31 | | | AUGERED TO 32' AND INSTALLED TEMPORARY WELL. |
| | | 32 | | | |
| | | 33 | | | * SOIL SAMPLE CHOSEN FOR LAB ANALYSES. |
| | | 34 | | | |
| | | 35 | | | |
| | | 36 | | | |
| | | 37 | | | |
| | | 38 | | | |
| | | 39 | | | |
| | | 40 | | | |
| | | 41 | | | |

LITHO. PROFILE

WELL COMPLETION



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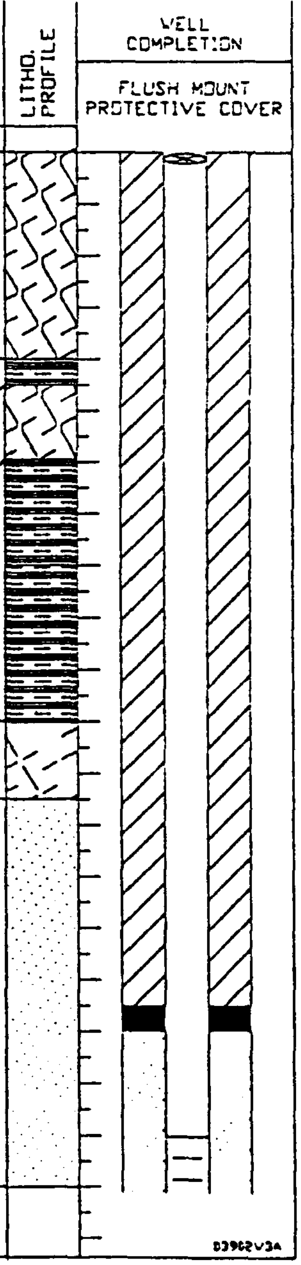
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER JANG-2-SB/MW-3/TW-3 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 29 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | |
|---|---|---|---|
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 50-100 | 0<br>1 | ☒ | 1<br>5<br>4 | BROWN, DAMP, NON-PLASTIC SILT, [ML], NO ODOR. |
| | | | | 4 | |
| *<br>S-2<br>(S1) | 50-100 | 2<br>3 | ☒ | 2<br>4<br>3 | SAME AS ABOVE. |
| | | | | 2 | |
| S-3 | 50-100 | 4<br>5 | ☒ | 2<br>4<br>3<br>4 | BROWN & GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-4 | 50-100 | 6<br>7 | ☒ | 2<br>3<br>4 | BROWN, DAMP, NON-PLAST, SILT, [ML], NO ODOR. |
| | | | | 6 | BROWN & GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| *<br>S-5<br>(S2) | 50-100 | 8<br>9 | ☒ | 2<br>3<br>4 | SAME AS ABOVE, NO ODOR. |
| | | | | 7 | |
| S-6 | 50-100 | 10<br>11 | ☒ | 1<br>4<br>7<br>5 | BROWN, DAMP, NON-PLASTIC, SILT, [ML], NO ODOR. |
| S-7 | 50-100 | 12<br>13 | ☒ | 3<br>6<br>5<br>5 | BROWN, DAMP, NON-PLASTIC, WELL SORTED ( POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| S-8 | 50-100 | 14<br>15 | ☒ | 4<br>3<br>4<br>3 | SAME AS ABOVE, NO ODOR. |
| S-9 | 50-100 | 16<br>17 | ☒ | 2<br>4<br>4<br>4 | SAME AS ABOVE, NO ODOR. |
| S-10 | 50-100 | 18<br>19 | ☒ | 3<br>4<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| | | 20<br>21 | | | CONTINUED ON NEXT PAGE. |



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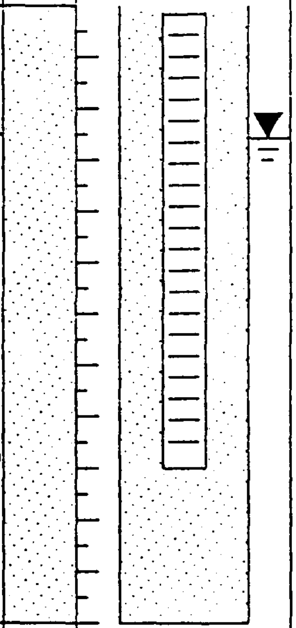
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-3/TW-3 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 29 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | |
|---|---|---|---|
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| *<br>S-11<br>(S3)<br>**<br>(S4) | 50-100 | 20<br>21<br>22 | ☒ | 3<br>4<br>5<br>4 | BROWN, DAMP TO MOIST, NON-PLASTIC WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED, SAND, [SM], NO ODOR. |
| S-12 | 50-100 | 23<br>24 | ☒ | 2<br>2<br>2<br>2 | GRAY, WET, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED, SAND, [SM], SLIGHT DECAYING ORGANICS ODOR, WATER TABLE @ 22.5'. |
| S-13 | 50-100 | 25<br>26 | ☒ | 2<br>2<br>2<br>3 | |
| S-14 | 50-100 | 27<br>28 | ☒ | 2<br>3<br>5<br>5 | SAME AS ABOVE, DECAYING ORGANICS ODOR. |
| S-15 | 50-100 | 29<br>30 | ☒ | 1<br>2<br>3<br>3 | SAME AS ABOVE, LITTLE CLAY, DECAYING ORGANICS ODOR. |
| | | 31<br>32 | | | AUGERED TO 32' AND INSTALLED TEMPORARY WELL. |
| | | 33<br>34<br>35<br>36<br>37<br>38<br>39<br>40<br>41 | | | * SOIL SAMPLE CHOSEN FOR LAB ANALYSES.<br>** DUPLICATE SAMPLE OF S3. |

LITHO. PROFILE

WELL COMPLETION



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LOCATION MAP

SEE FIGURE 3.4

ELEVATION

## ENGINEERING-SCIENCE WELL LOG

PAGE 1 OF 2

| | | | |
|---|---|---|---|
| WELL NUMBER | IANG-2-SB/MW-4/TW-4 | LOCATION | SITE 2 - RAD. SITE |
| DATE | 29 JULY 1990 | WEATHER | 80°F, SUNNY |
| LOCATED BY | TAB/KMP | DRILLED BY | FOX DRLG. |
| DRILLING METHOD | HOLLOW-STEM AUGER | SAMPLING METHOD | SPLIT-SPOON |
| GRAVEL PACK | SAND (30/70) | SEAL | BENTONITE |

CASING TYPE SCH 40 PVC DIAMETER 2' LENGTH 19' HOLE DIA. 9 3/4"

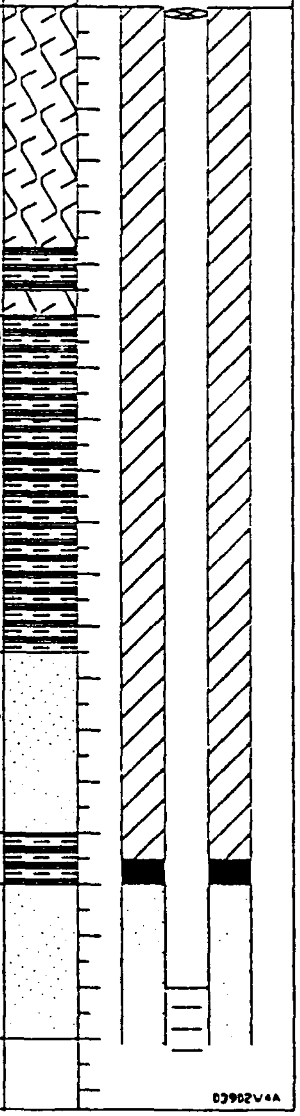
SCREEN TYPE SCH 40 PVC SLOT 0.010" DIAMETER 2' LENGTH 10' TOTAL DEPTH 32'

| SAMPLE NO. | COUNTS/MINUTE (CPM) | DEPTH | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|
| S-1 | 50-100 | 0<br>1 | 2<br>2<br>2<br>3 | BROWN, DAMP, NON-PLASTIC, SILT, [ML], NO ODOR. |
| *<br>S-2 (S1) | 50-100 | 2<br>3 | 3<br>2<br>3<br>2 | SAME AS ABOVE, NO ODOR. |
| S-3 | 50-100 | 4<br>5 | 3<br>4<br>4<br>6 | SAME AS ABOVE, NO ODOR. INTERBEDS OF BROWN, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-4 | 50-100 | 6<br>7 | 2<br>2<br>4<br>4 | BROWN, DAMP, PLASTIC, SILTY CLAY, [CL] NO ODOR. |
| *<br>S-5 (S2) | 50-100 | 8<br>9 | 3<br>4<br>6<br>7 | SAME AS ABOVE, NO ODOR. |
| S-6 | 50-100 | 10<br>11 | 2<br>4<br>6<br>9 | SAME AS ABOVE, NO ODOR. |
| S-7 | 50-100 | 12<br>13 | 3<br>3<br>4<br>5 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| S-8 | 50-100 | 14<br>15 | 2<br>4<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| S-9 | 50-100 | 16<br>17 | 2<br>1<br>5<br>4 | GRAY, DAMP, PLASTIC, WELL SORTED SILTY CLAY, [CL], NO ODOR.<br>GRAY & BROWN, DAMP, NON-PLASTIC, WELL SORTED, (POORLY GRADED), SILTY SAND [SM], NO ODOR. |
| S-10 | 50-100 | 18<br>19 | 1<br>2<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| | | 20<br>21 | | CONTINUED ON NEXT PAGE. |

LITHO. PROFILE

WELL COMPLETION

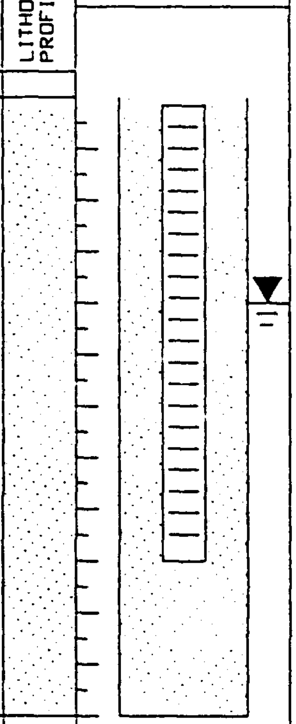
FLUSH MOUNT PROTECTIVE COVER



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-4/TW-4 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 30 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH 40 PVC | | DIAMETER 2" | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC | SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| * S-11 (S3) | 50-100 | 20-22 | X | 5<br>2<br>6<br>8 | BROWN, DAMP, NON-PLASTIC, WELL SORTED, (POORLY GRADED), SILTY SAND, [SM], NO ODOR. |
| S-12 | 50-100 | 22-24 | X | 8<br>20<br>21<br>22 | SAME AS ABOVE, NO ODOR. |
| S-13 | 50-100 | 24-26 | X | 7<br>8<br>8<br>7 | SAME AS ABOVE, WET @ 24', NO ODOR. |
| S-14 | 50-100 | 26-28 | X | 3<br>3<br>4<br>5 | SAME AS ABOVE, WET, NO ODOR. |
| S-15 | 50-100 | 28-30 | X | 3<br>5<br>8<br>8 | SAME AS ABOVE, WET, NO ODOR. |
| | | 31-32 | | | AUGERED TO 32' AND INSTALLED TEMPORARY WELL. |
| | | 33-41 | | | * SAMPLE CHOSEN FOR LAB ANALYSES. |



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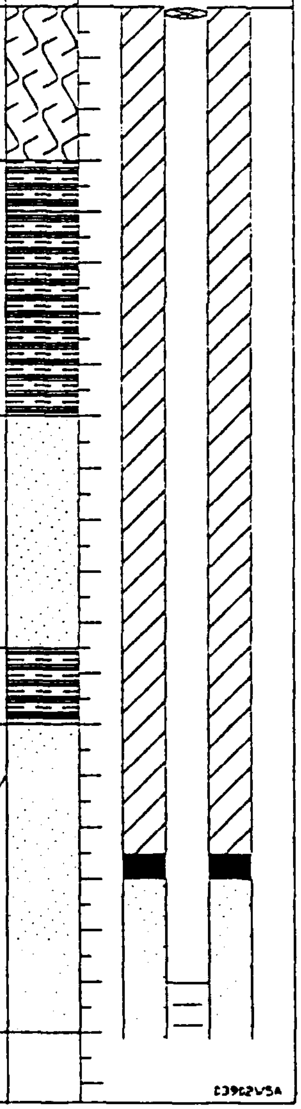
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-5/TW-5 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 30 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 50-100 | 0-2 | | 2<br>2<br>2<br>2 | BROWN, DAMP, NON-PLASTIC SILT, [ML], NO ODOR. |
| *<br>S-2 (S1) | 50-100 | 2-4 | | 1<br>2<br>2<br>3 | BROWN & GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-3 | 50-100 | 4-6 | | 2<br>1<br>2<br>4 | SAME AS ABOVE, NO ODOR. |
| S-4 | 50-100 | 6-8 | | 1<br>2<br>4<br>6 | SAME AS ABOVE, NO ODOR. |
| *<br>S-5 (S2) | 50-100 | 8-10 | | 2<br>3<br>4<br>2 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED SAND [SM], NO ODOR. |
| S-6 | 50-100 | 10-12 | | 5<br>6<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| S-7 | 50-100 | 12-14 | | 1<br>2<br>3<br>4 | BROWN & GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-8 | 50-100 | 14-16 | | 2<br>5<br>3<br>3 | BROWN, DAMP, NON-PLASTIC, VERY WELL SORTED (POORLY GRADED), SILTY, CLAYEY, SAND, [SM], NO ODOR.<br>BROWN, DAMP, NON-PLASTIC, WELL SORTED ( POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| S-9 | 50-100 | 16-18 | | 9<br>15<br>24<br>27 | SAME AS ABOVE, NO ODOR. |
| S-10 | 50-100 | 18-20 | | 8<br>16<br>16<br>12 | SAME AS ABOVE, NO ODOR. |
| | | 20-21 | | | CONTINUED ON NEXT PAGE. |

LITHO. PROFILE

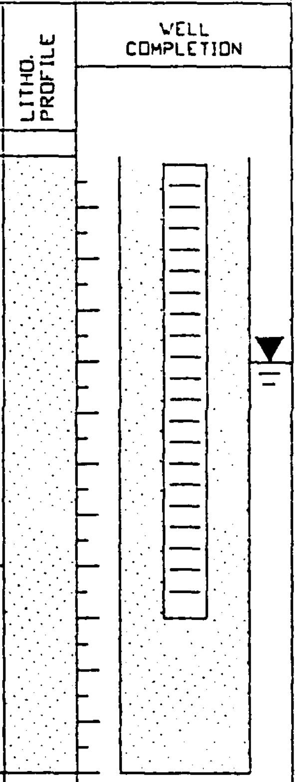
WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.4 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-2-SB/MW-5/TW-5 | LOCATION SITE 2 - RAD. SITE | |
| | DATE 30 JULY 1990 | WEATHER 80°F, SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRLG. | |
| | DRILLING METHOD HOLLOW-STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH 40 PVC | DIAMETER 2" | LENGTH 19' | HOLE DIA. 9 3/4" |
| SCREEN TYPE SCH 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | COUNTS/ MINUTE (CPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| * S-11 (S3)<br>** (S4) | 50-100 | 20<br>21<br>22 | | 5<br>7<br>20<br>18 | BROWN, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED SILTY SAND, [SM], NO ODOR. |
| S-12 | 50-100 | 23<br>24 | | 10<br>13<br>15<br>17 | SAME AS ABOVE, NO ODOR. |
| S-13 | 50-100 | 25<br>26 | | 9<br>7<br>6<br>7 | SAME AS ABOVE, WET @ 24', NO ODOR. |
| S-14 | 50-100 | 27<br>28 | | 3<br>5<br>7<br>8 | SAME AS ABOVE, WET, NO ODOR. |
| S-15 | 50-100 | 29<br>30 | | 2<br>1<br>3<br>3 | GRAY, WET, NON-PLASTIC, WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED, SAND, [SM], NO ODOR. |
| | | 31<br>32 | | | AUGERED TO 32' AND INSTALLED TEMPORARY WELL. |
| | | 33<br>34<br>35<br>36<br>37<br>38<br>39<br>40<br>41 | | | * SAMPLE CHOSEN FOR LAB ANALYSES.<br>** DUPLICATE SAMPLE OF S3. |



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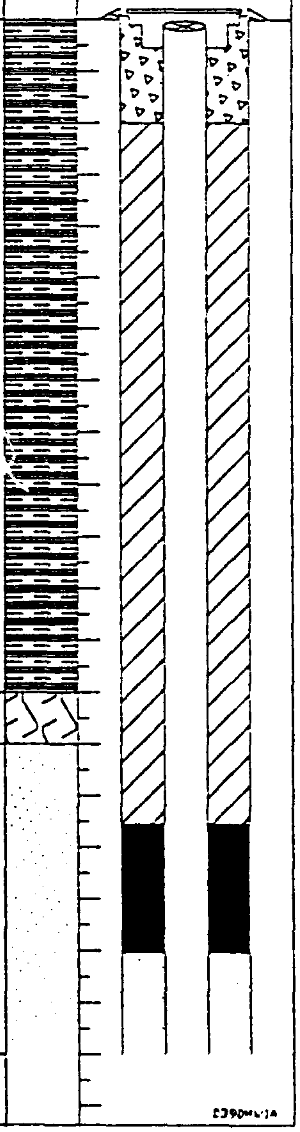
|  |  |  |  |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3 | ENGINEERING-SCIENCE WELL LOG |  | PAGE 1 OF 2 |
|  | WELL NUMBER IANG-1-SB/MW-1 | LOCATION SITE 1 - DEFUELING PIT |  |
|  | DATE 31 JULY 1990 | WEATHER 80'S - SUNNY |  |
|  | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING |  |
|  | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON |  |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE |  |
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 4.4 | 0<br>1 | ☒ | 1<br>2<br>7<br>1 | BROWN AND GRAY, DAMP, PLASTIC, SILTY CLAY [CL], NO ODOR. |
| S-2 | 4.8 | 2<br>3 | ☒ | 5<br>7<br>10<br>10 | SAME AS ABOVE, NO ODOR. |
| S-3 | 3.2 | 4<br>5 | ☒ | 4<br>4<br>7<br>8 | SAME AS ABOVE, NO ODOR. |
| S-4 | 2.5 | 6<br>7 | ☒ | 1<br>3<br>5<br>5 | SAME AS ABOVE, NO ODOR. |
| S-5 | 2.5 | 8<br>9 | ☒ | 1<br>3<br>4<br>4 | SAME AS ABOVE, NO ODOR. |
| S-6 | 2.4 | 10<br>11 | ☒ | 2<br>3<br>4<br>4 | SAME AS ABOVE, NO ODOR. |
| S-7 | 2.5 | 12<br>13 | ☒ | 1<br>3<br>3<br>3 | SAME AS ABOVE, NO ODOR.<br>BROWN, DAMP, NON-PLASTIC SILT [ML], LITTLE CLAY, NO ODOR. |
| S-8 | 56 | 14<br>15 | ☒ | 3<br>6<br>14<br>16 | GRAY, DAMP, NON-PLASTIC, WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND [SM], HYDROCARBON (H-C) ODOR. |
| S-9 | 2420 | 16<br>17 | ☒ | 7<br>13<br>17<br>19 | SAME AS ABOVE, H-C ODOR. |
| S-10 | 4511 | 18<br>19 | ☒ | 8<br>15<br>26<br>22 | SAME AS ABOVE, H-C ODOR. |
|  |  | 20<br>21 |  |  | CONTINUED ON PAGE 2 OF 2 |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



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| | |
|---|---|
| LOCATION MAP | SEE FIGURE 3.3 |
| ELEVATION | |

## ENGINEERING-SCIENCE WELL LOG

PAGE 2 OF 2

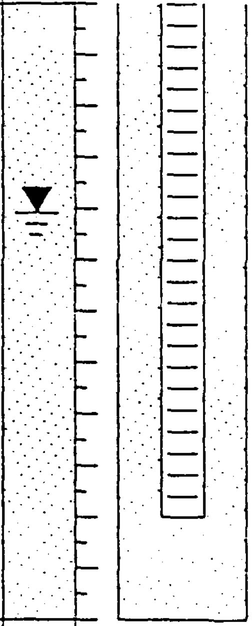
| | | | |
|---|---|---|---|
| WELL NUMBER | IANG-1-SB/MW-1 | LOCATION | SITE 1 - DEFUELING PIT |
| DATE | 31 JULY 1990 | WEATHER | 80'S - SUNNY |
| LOCATED BY | TAB/KMP | DRILLED BY | FOX DRILLING |
| DRILLING METHOD | HOLLOW STEM AUGER | SAMPLING METHOD | SPLIT-SPOON |
| GRAVEL PACK | SAND (30/70) | SEAL | BENTONITE |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CASING TYPE | SCH. 40 PVC | | | DIAMETER | 2" | LENGTH | 20' | HOLE DIA. | 9.75" |
| SCREEN TYPE | SCH. 40 PVC | SLOT | 0.010" | DIAMETER | 2" | LENGTH | 10' | TOTAL DEPTH | 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|
| | | 20 | | |
| * S-11 (S1) | 4920 | 21 | 10<br>18<br>22<br>19 | GRAY, DAMP, NON-PLASTIC, WELL-SORTED (POORLY GRADED), SILTY FINE-GRAINED SAND, [SM], H-C ODOR. |
| | | 22 | | |
| * S-12 (S2) | 4790 | 23 | 5<br>10<br>17<br>13 | SAME AS ABOVE, H-C ODOR. |
| | | 24 | | |
| S-13 | 3880 | 25 | 3<br>7<br>10<br>13 | SAME AS ABOVE, WET @ 24', H-C ODOR. |
| | | 26 | | |
| S-14 | 3120 | 27 | 9<br>8<br>7<br>10 | SAME AS ABOVE, WET, H-C ODOR. |
| | | 28 | | |
| S-15 | 510 | 29 | 3<br>6<br>9<br>6 | SAME AS ABOVE, WET, H-C ODOR. |
| | | 30 | | |
| | | 31 | | AUGERED TO 32' AND INSTALLED IANG-1-MW-1 |
| | | 32 | | |
| | | 33 | | * SAMPLES CHOSEN FOR LABORATORY ANALYSES. |
| | | 34 | | |
| | | 35 | | |
| | | 36 | | |
| | | 37 | | |
| | | 38 | | |
| | | 39 | | |
| | | 40 | | |
| | | 41 | | |

LITHO. PROFILE

WELL COMPLETION



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# ENGINEERING-SCIENCE WELL LOG

| | |
|---|---|
| LOCATION MAP | SEE FIGURE 3.3 |
| ELEVATION | |
| PAGE | 1 OF 2 |
| WELL NUMBER | IANG-1-SB-3/MW-2 |
| LOCATION | SITE 1 - DEFUELING PIT |
| DATE | 6 AUGUST 1990 |
| WEATHER | 80'S - SUNNY |
| LOCATED BY | TAB/KMP |
| DRILLED BY | FOX DRILLING |
| DRILLING METHOD | HOLLOW STEM AUGER |
| SAMPLING METHOD | SPLIT-SPOON |
| GRAVEL PACK | SAND (30/70) |
| SEAL | BENTONITE |

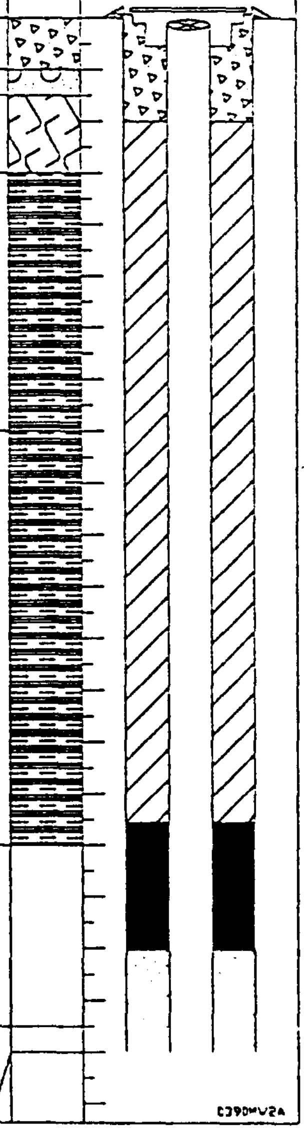
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CASING TYPE | SCH. 40 PVC | | | DIAMETER | 2" | LENGTH | 20' | HOLE DIA. | 9.75" |
| SCREEN TYPE | SCH. 40 PVC | SLOT | 0.010" | DIAMETER | 2" | LENGTH | 10' | TOTAL DEPTH | 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 0 | | | CONCRETE |
| | | 1 | | | SAND AND GRAVEL SUB-BASE |
| | | 2 | | 2<br>5 | BROWN, DAMP, NON-PLASTIC SILT [ML], NO ODOR. |
| S-1 | 250 | 3 | | 4<br>6 | DARK, GRAY, DAMP, PLASTIC, SILTY CLAY [CL], NO ODOR. |
| S-2 | 150 | 5 | | 2<br>3<br>5<br>5 | |
| S-3 | 24 | 7 | | 2<br>4<br>7<br>7 | SAME AS ABOVE, NO ODOR. |
| S-4 | 120 | 9 | | 2<br>4<br>8<br>7 | GRAY AND BROWN, DAMP, PLASTIC, SILTY CLAY [CL], NO ODOR. |
| S-5 | 50 | 11 | | 2<br>3<br>4<br>3 | SAME AS ABOVE, NO ODOR. |
| S-6 | 3.5 | 13 | | 1<br>3<br>4<br>5 | SAME AS ABOVE, NO ODOR. |
| S-7 | 4.4 | 15 | | 1<br>3<br>3<br>3 | SAME AS ABOVE, NO ODOR. |
| S-8 | 25 | 17 | | 1<br>3<br>4<br>3 | GRAY, DAMP TO MOIST SILT [ML], NO ODOR. |
| S-9 | 55 | 19 | | 1<br>2<br>10<br>18 | BROWN, MOIST, WELL SORTED (POORLY GRADED) SILTY SAND [SM], SLIGHT HYDROCARBON (H-C) ODOR. |
| | | 21 | | | |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



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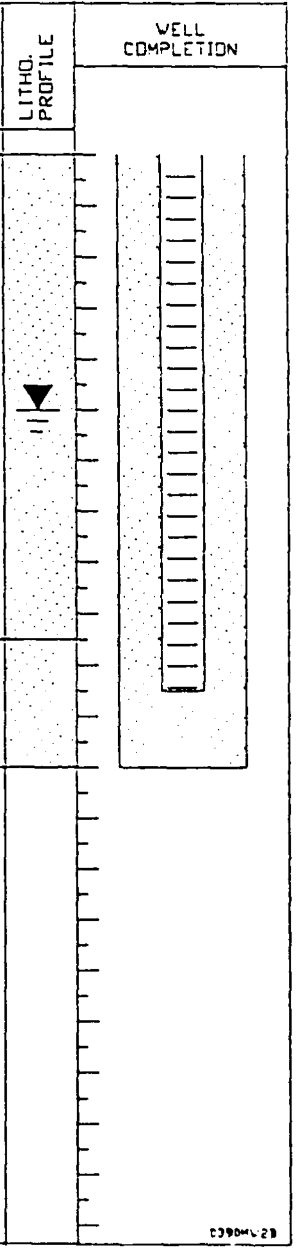
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-3/MW-2 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 6 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2' | LENGTH 20' | HOLE DIA. 9.75' |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010' | DIAMETER 2' | LENGTH 10' | TOTAL DEPTH 32' |

| | SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|---|
| | S-10 | 88 | 20–22 | X | 8<br>15<br>20<br>26 | BROWN, DAMP TO MOIST, WELL SORTED (POORLY GRADED)SILTY SAND [SM], SLIGHT H-C ODOR. |
| * | S-11 (S1) | 3637 | 22–24 | X | 9<br>18<br>17<br>13 | SAME AS ABOVE, H-C ODOR. |
| * | S-12 (S2) | 2811 | 24–26 | X | 6<br>6<br>7<br>8 | SAME AS ABOVE, WET @ 25', H-C ODOR. |
| | S-13 | 38 | 26–28 | X | 1<br>1<br>2<br>3 | |
| | S-14 | 32 | 28–30 | X | 2<br>5<br>7<br>7 | SAME AS ABOVE, WET, SLIGHT H-C ODOR. |
| | | | 30–32 | | | BROWN, WET, MODERATELY SORTED (POORLY GRADED) SILTY SAND [SP], SLIGHT TO NO H-C ODOR. |
| | | | 32–41 | | | AUGERED TO 32' AND INSTALLED WELL.<br><br>* SAMPLES CHOSEN FOR LABORATORY ANALYSES. |



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-4/MW-3 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 7 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | |
|---|---|---|---|
| CASING TYPE SCH. 40 PVC | DIAMETER 2' | LENGTH 20' | HOLE DIA. 9.75' |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 0 | | 3<br>5 | |
| S-1 | 300 | 1 | | 8<br>7 | GRAY, DAMP, PLASTIC, SILTY, CLAY, [CL], NO ODOR, SOME ORGANICS (GRASS ROOTS). |
| | | 2 | | 3<br>5 | |
| S-2 | 38 | 3 | | 9<br>12 | SAME AS ABOVE, NO ODOR. |
| | | 4 | | 3<br>6 | |
| S-3 | 15 | 5 | | 6<br>9 | SAME AS ABOVE, NO ODOR. |
| | | 6 | | 2<br>4 | |
| S-4 | 15.9 | 7 | | 6<br>8 | SAME AS ABOVE, NO ODOR. |
| | | 8 | | 2<br>6 | |
| S-5 | 9.7 | 9 | | 9<br>12 | SAME AS ABOVE, NO ODOR. |
| | | 10 | | 4<br>6 | BROWN, DAMP, VERY WELL SORTED (POORLY GRADED), VERY FINE-GRAINED SILTY SAND, [SM], NO ODOR. |
| S-6 | 115 | 11 | | 9<br>12 | |
| | | 12 | | 9<br>12 | |
| S-7 | 37 | 13 | | 16<br>16 | SAME AS ABOVE, NO ODOR. |
| | | 14 | | 9<br>13 | |
| S-8 | 56 | 15 | | 14<br>20 | |
| | | 16 | | 10<br>19 | GRAY, DAMP, VERY WELL SORTED (POORLY GRADED) VERY FINE-GRAINED SILTY SAND, [SM], SLIGHT HYDROCARBON (H-C) ODOR. |
| S-9 | 6190 | 17 | | 24<br>23 | |
| | | 18 | | 8<br>13 | SAME AS ABOVE, STRONG H-C ODOR. |
| * S-10 (S1) | 6209 | 19 | | 14<br>20 | SAME AS ABOVE, H-C ODOR. |
| | | 20 | | | |
| | | 21 | | | |

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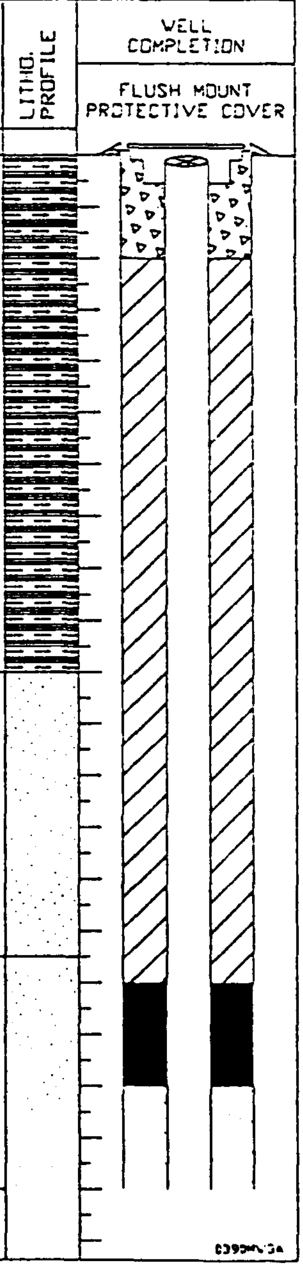
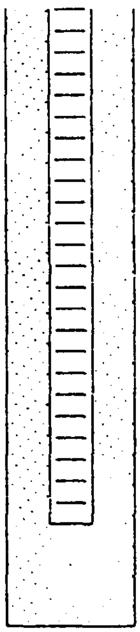


| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-4/MW-3 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 7 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2' | LENGTH 20' | HOLE DIA. 9.75' |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010' | DIAMETER 2' | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) | LITHO. PROFILE |
|---|---|---|---|---|---|---|
| | | 20 | ☒ | 7<br>10 | GRAY, DAMP, VERY WELL-SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], H-C ODOR. | |
| * S-11 (S2) | 6748 | 21 | | 18<br>19 | | |
| | | 22 | ☒ | 5<br>5 | SAME AS ABOVE, MOIST WITH HYDROCARONS, STRONG H-C ODOR. | |
| S-12 | 5980 | 23 | | 8<br>9 | | |
| | | 24 | ☒ | 4<br>6 | SAME AS ABOVE, WATER @ 24', H-C ODOR. | ▼ |
| S-13 | 2033 | 25 | | 8<br>9 | | |
| | | 26 | ☒ | 4<br>13 | SAME AS ABOVE, WET, H-C ODOR. | |
| S-14 | 115 | 27 | | 26<br>23 | | |
| | | 28 | ☒ | 4<br>5 | | |
| S-15 | 619 | 29 | | 6<br>5 | GRAY, WET MODERATELY SORTED (POORLY GRADED), SILTY SAND, [SP], H-C ODOR. | |
| | | 30 | | | | |
| | | 31 | | | AUGERED TO 32' AND INSTALLED WELL. | |
| | | 32 | | | | |
| | | 33 | | | * SOIL SAMPLE CHOSEN FOR LAB ANALYSES. | |
| | | 34 | | | | |
| | | 35 | | | | |
| | | 36 | | | | |
| | | 37 | | | | |
| | | 38 | | | | |
| | | 39 | | | | |
| | | 40 | | | | |
| | | 41 | | | | |

WELL COMPLETION



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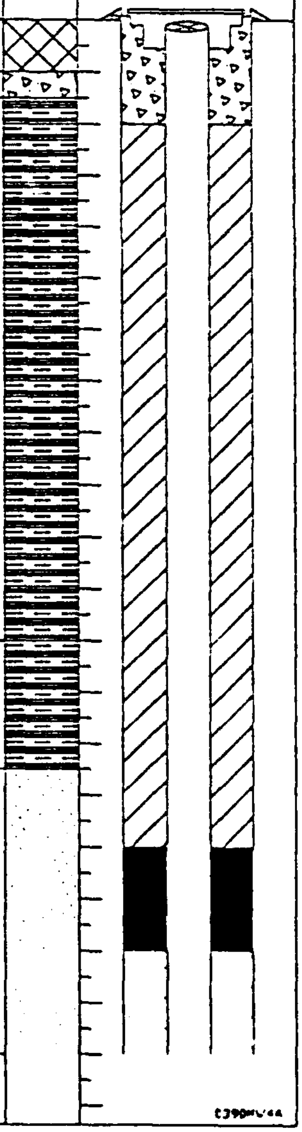
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-5/MW-4 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 7 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 0 | | | |
| | | | | | CONCRETE |
| | | 1 | | | SAND AND GRAVEL SUB-BASE. |
| | | 2 | | | |
| S-1 | 65 | 3 | | 2<br>3<br>4<br>4 | GRAY, DAMP, PLASTIC, SILTY <u>CLAY</u>, [CL], NO ODOR. |
| | | 4 | | | |
| S-2 | 129 | 5 | | 3<br>4<br>6<br>6 | SAME AS ABOVE, NO ODOR. |
| | | 6 | | | |
| S-3 | 250 | 7 | | 1<br>3<br>5<br>5 | SAME AS ABOVE, NO ODOR. |
| | | 8 | | | |
| S-4 | 150 | 9 | | 1<br>3<br>5<br>5 | SAME AS ABOVE, NO ODOR. |
| | | 10 | | | |
| S-5 | 100 | 11 | | 1<br>1<br>3<br>4 | SAME AS ABOVE, NO ODOR.<br>8/7/90 |
| | | 12 | | | |
| S-6 | 33 | 13 | | 1<br>2<br>4<br>5 | 8/8/90<br>SAME AS ABOVE, NO ODOR. |
| | | 14 | | | |
| S-7 | 21 | 15 | | 3<br>4<br>5<br>4 | GRAY-BROWN, DAMP, VERY WELL SORTED (POORLY GRADED), SILTY, FINE-GRAINED <u>SAND</u>, [SM], NO ODOR W/ INTERBEDS OF SILTY <u>CLAY</u>. |
| | | 16 | | | |
| S-8 | 66 | 17 | | 5<br>4<br>13<br>18 | SAME AS ABOVE WITH HYDROCARBON (H-C) ODOR @ APPROX. 17'. |
| | | 18 | | | |
| S-9 | 4256 | 19 | | 8<br>20<br>27<br>32 | SAME AS ABOVE, H-C ODOR. |
| | | 20 | | | |
| | | 21 | | | CONTINUED ON PAGE 2 OF 2 |

LITHO. PROFILE

WELL COMPLETION

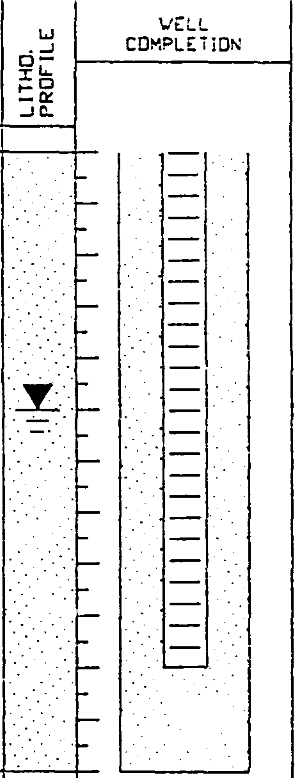
FLUSH MOUNT PROTECTIVE COVER



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-5/MW-4 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 8 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | |
|---|---|---|---|
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| * S-10 (S1) | 4500 | 20–22 | | 7<br>13<br>20<br>19 | GRAY, BROWN, DAMP, VERY WELL-SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], H-C ODOR. |
| S-11 | 3860 | 22–24 | | 6<br>13<br>17<br>16 | SAME AS ABOVE, H-C ODOR, MOIST WITH HYDROCARBONS. |
| * S-12 (S2) | 5000 | 24–26 | | 5<br>3<br>4<br>3 | SAME AS ABOVE, H-C ODOR, WATER @ 25'. |
| S-13 | 2140 | 26–28 | | 3<br>4<br>4<br>6 | SAME AS ABOVE, WET, H-C ODOR. |
| S-14 | 274 | 28–30 | | 3<br>4<br>5<br>8 | SAME AS ABOVE, WET, H-C ODOR. |
| | | 30–32 | | | AUGERED TO 32' AND INSTALLED WELL. |
| | | 32–41 | | | * SAMPLES CHOSEN FOR LABORATORY ANALYSES. |



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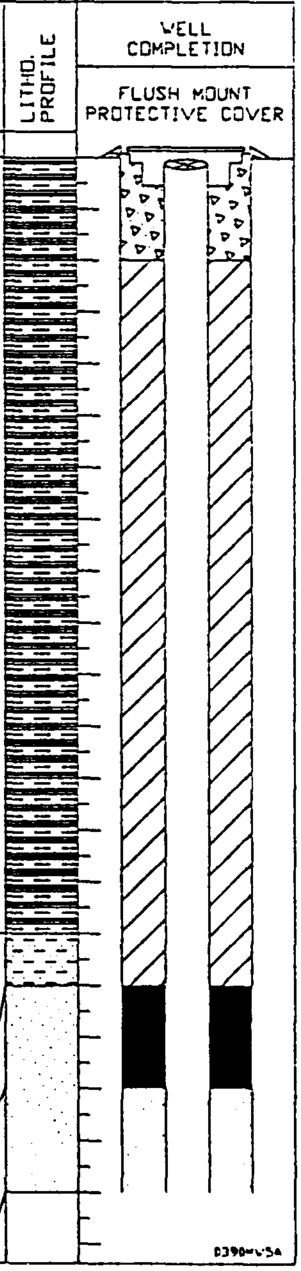
| | | |
|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-6/MW-5 | LOCATION SITE 1 - DEFUELING PIT |
| | DATE 9 AUGUST 1990 | WEATHER 80'S - SUNNY |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE |

| | | | | | |
|---|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 236 | 0–2 | ☒ | 2<br>4<br>6<br>9 | GRAY-BROWN, DAMP, SLIGHT PLASTICITY, SILTY CLAY, [CL], NO ODOR. |
| S-2 | 58 | 2–4 | ☒ | 4<br>5<br>9<br>14 | SAME AS ABOVE, NO ODOR. |
| * S-3 (S1) | 119 | 4–6 | ☒ | 4<br>8<br>14<br>15 | SAME AS ABOVE, NO ODOR. |
| S-4 | 47 | 6–8 | ☒ | 4<br>5<br>9<br>15 | SAME AS ABOVE, NO ODOR. |
| S-5 | 0 | 8–10 | ☒ | 2<br>4<br>8<br>9 | SAME AS ABOVE, NO ODOR. |
| S-6 | 1.3 | 10–12 | ☒ | 2<br>5<br>7<br>7 | SAME AS ABOVE, NO ODOR. |
| S-7 | 0.1 | 12–14 | ☒ | 2<br>4<br>5<br>5 | SAME AS ABOVE, MOIST, NO ODOR. |
| S-8 | 1.5 | 14–16 | ☒ | 2<br>4<br>3<br>3 | BROWN, DAMP, WELL SORTED (POORLY GRADED), SILTY FINE-GRAINED SAND, [SM], WITH INTERBEDS (3") OF SILTY CLAY AS ABOVE. NO ODOR. |
| S-9 | 1.7 | 16–18 | ☒ | 2<br>5<br>9<br>10 | SAME AS ABOVE, NO CLAY INTERBEDS, NO ODOR. |
| S-10 | 1.7 | 18–20 | ☒ | 6<br>13<br>19<br>21 | GRAY, MOIST VERY WELL SORTED (POORLY GRADED), FINE GRAINED, SILTY SAND, [SM], SLIGHT H-C, SLIGHT DECAYING ORGANICS ODOR. |
| | | 21 | | | CONTINUED ON PAGE 2 OF 2 |

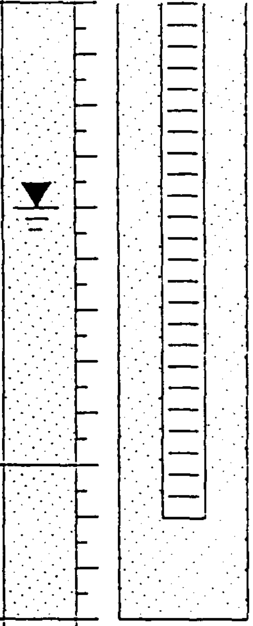


| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-6/MW-5 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 9 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| | | 20 | X | 12 | |
| | | | X | 19 | GRAY, DAMP TO MOIST, VERY WELL SORTED (POORLY GRADED), FINE-GRAINED SILTY SAND [SM], NO H-C ODOR, SLIGHT DECAYING ORGANICS ODOR. |
| S-11 | 1.3 | 21 | X | 23 | |
| | | | X | 21 | |
| | | 22 | X | 9 | |
| | | | X | 13 | |
| S-12 | 0 | 23 | X | 12 | SAME AS ABOVE, NO H-C ODOR. |
| | | | X | 10 | |
| | | 24 | X | 4 | SAME AS ABOVE, WATER @ 24'. NO H-C ODOR. |
| | | | X | 6 | |
| S-13 | 0 | 25 | X | 6 | |
| | | | | 4 | |
| | | 26 | X | 3 | SAME AS ABOVE, WET, SWEET ODOR, (POSSIBLY H-C). |
| | | | X | 6 | |
| * S-14 (S2) | 2.9 | 27 | X | 5 | |
| | | | X | 7 | |
| | | 28 | X | 3 | |
| | | | X | 3 | |
| S-15 | 3.4 | 29 | X | 4 | GRAY, WET MODERATELY SORTED (POORLY GRADED), SILTY SAND [SP], LITTLE GRAVEL, SOME ODOR AS ABOVE, POSSIBLY H-C. |
| | | | X | 3 | |
| | | 30 | | | |
| | | 31 | | | |
| | | 32 | | | AUGERED TO 32' AND INSTALLED WELL. |
| | | 33 | | | |
| | | 34 | | | |
| | | 35 | | | * SAMPLES CHOSEN FOR LABORATORY ANALYSES. |
| | | 36 | | | |
| | | 37 | | | |
| | | 38 | | | |
| | | 39 | | | |
| | | 40 | | | |
| | | 41 | | | |

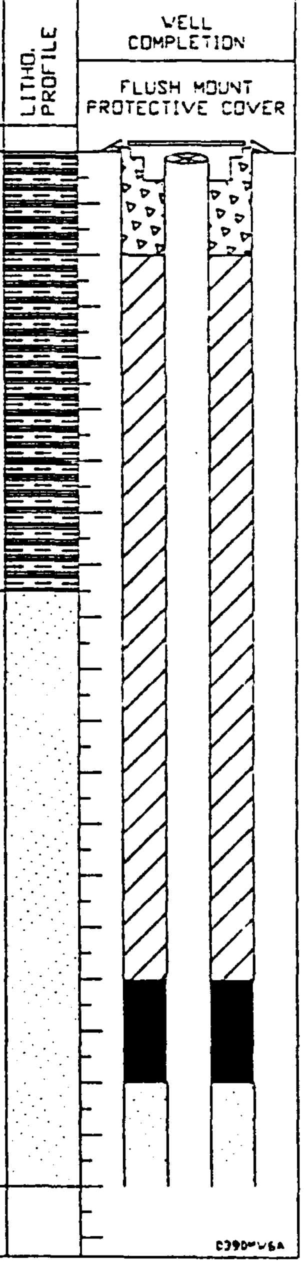
LITHO. PROFILE | WELL COMPLETION



|  |  |  |  |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-7/MW-6 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 10 AUGUST 1990 | WEATHER 70'S - OVERCAST | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

|  |  |  |  |
|---|---|---|---|
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

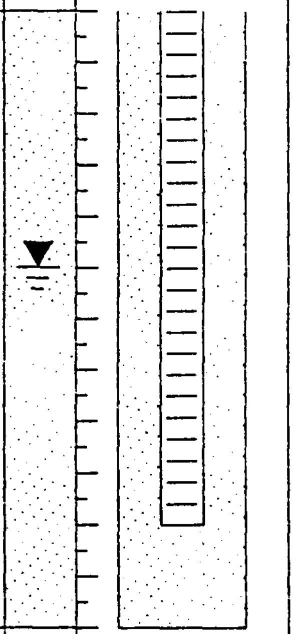
| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 212 | 0–2 | ☒ | 2<br>4<br>4<br>6 | BROWN, DAMP, PLASTIC, SILTY, <u>CLAY</u>, [CL], NO ODOR, SOME ORGANICS (GRASS ROOTS). |
| S-2 | 160 | 2–4 | ☒ | 4<br>5<br>9<br>10 | SAME AS ABOVE, NO ODOR. |
| S-3 | 67 | 4–6 | ☒ | 3<br>4<br>9<br>10 | SAME AS ABOVE, NO ODOR. |
| S-4 | 24 | 6–8 | ☒ | 1<br>3<br>4<br>4 | SAME AS ABOVE, NO ODOR. |
| * S-5 (S1) | 139 | 8–10 | ☒ | 1<br>3<br>12<br>11 | BROWN, DAMP, VERY WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY <u>SAND</u>, [SM], NO ODOR. |
| S-6 | 54 | 10–12 | ☒ | 6<br>8<br>5<br>4 | SAME AS ABOVE, NO ODOR. |
| S-7 | 24 | 12–14 | ☒ | 2<br>2<br>2<br>2 | SAME AS ABOVE, NO ODOR. |
| S-8 | 8 | 14–16 | ☒ | 2<br>2<br>4<br>5 | SAME AS ABOVE, NO ODOR. |
| S-9 | 9 | 16–18 | ☒ | 5<br>6<br>12<br>15 | SAME AS ABOVE, MOIST, NO ODOR. |
| S-10 | 14 | 18–20 | ☒ | 7<br>11<br>17<br>22 | SAME AS ABOVE, MOIST, NO ODOR. |
| | | 20–21 | | | CONTINUED ON PAGE 2 OF 2 |



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-7/MW-6 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 10 AUGUST 1990 | WEATHER 70'S - OVERCAST | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) | LITHO. PROFILE |
|---|---|---|---|---|---|---|
| S-11<br>* (S2)<br>** (S2-D) | 77 | 20–22 | | 11<br>13<br>11<br>8 | BROWN, MOIST, VERY WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. | |
| S-12<br>*** (BR1) | 46 | 22–24 | | 8<br>8<br>6<br>7 | SAME AS ABOVE, NO ODOR. | |
| S-13 | 51 | 24–26 | | 3<br>7<br>9<br>6 | SAME AS ABOVE, WATER @ 25', NO ODOR. | ▼ |
| S-14<br>*** (BR2)<br>** (BR2-D) | 43 | 26–28 | | 3<br>4<br>9<br>11 | SAME AS ABOVE, NO ODOR. | |
| S-15 | 35 | 28–30 | | 3<br>4<br>6<br>7 | SAME AS ABOVE, NO ODOR. | |
| | | 30–32 | | | AUGERED TO 32' AND INSTALLED WELL | |
| | | 32–41 | | | | |



* SAMPLES CHOSEN FOR LABORATORY ANALYSES.

** SAMPLES CHOSEN FOR DUPLICATE.

*** SAMPLES CHOSEN FOR GROSS ALPHA/BETA, RADIUM 226, RADIUM 228 ANALYSES.

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| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-8/MW-7 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 11 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

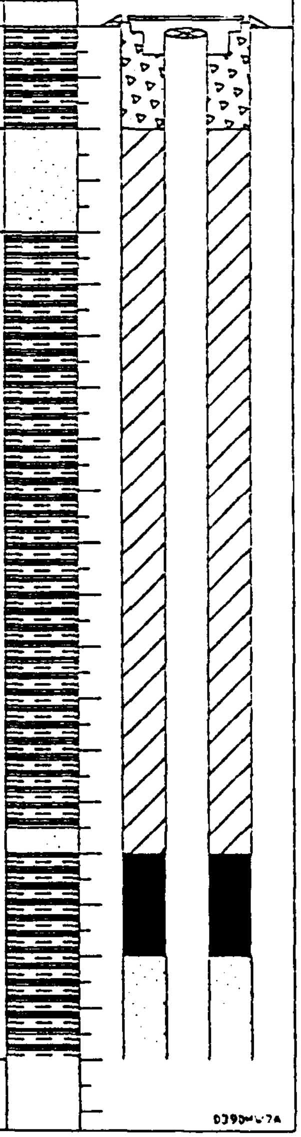
| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH. 40 PVC | | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC | SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 69 | 0<br>1 | ☒ | 3<br>3<br>7<br>9 | BROWN AND GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. (SOME ORGANICS, GRASS ROOTS). |
| S-2 | 35 | 2<br>3 | ☒ | 6<br>9<br>9<br>12 | BROWN, DAMP, NON-PLASTIC SILT, [ML], NO ODOR. |
| S-3 | 65 | 4<br>5 | ☒ | 6<br>6<br>7<br>9 | BROWN AND GRAY, DAMP, PLASTIC, SILTY CLAY, [CL], NO ODOR. |
| S-4 | 64 | 6<br>7 | ☒ | 2<br>2<br>5<br>6 | SAME AS ABOVE, NO ODOR. |
| * S-5 (S1) | 65 | 8<br>9 | ☒ | 2<br>3<br>6<br>7 | SAME AS ABOVE, NO ODOR. |
| S-6 | 0 | 10<br>11 | ☒ | 2<br>3<br>4<br>5 | SAME AS ABOVE, NO ODOR. |
| S-7 | 0 | 12<br>13 | ☒ | 2<br>3<br>6<br>7 | SAME AS ABOVE, NO ODOR. |
| S-8 | 2.7 | 14<br>15 | ☒ | 2<br>3<br>4<br>3 | SAME AS ABOVE, NO ODOR.<br>15.5'-15.7' BROWN, SILTY SAND, [SM], LENS, MOIST, NO ODOR. |
| S-9 | 0 | 16<br>17 | ☒ | 1<br>2<br>4<br>3 | SAME AS ABOVE, NO ODOR. |
| S-10 | 0 | 18<br>19 | ☒ | 1<br>1<br>1<br>2 | SAME AS ABOVE, MOIST, NO ODOR. |
| | | 20<br>21 | | | CONTINUED ON PAGE 2 OF 2 |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



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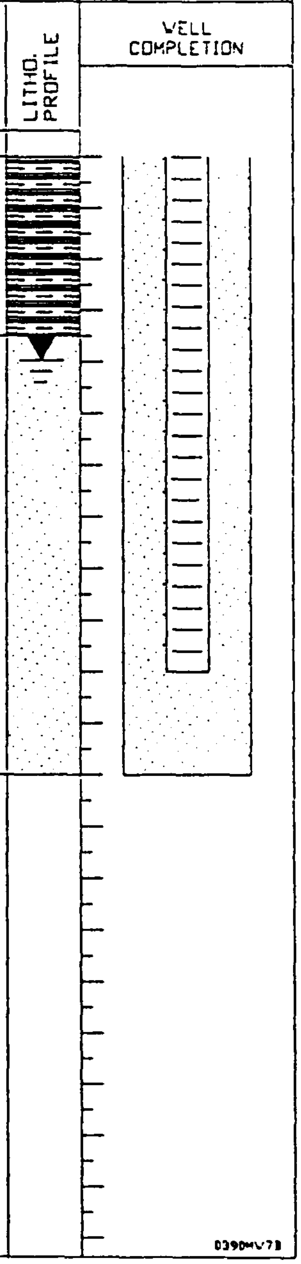
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3 | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-8/MW-7 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 11 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75' |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-11 | 0 | 20-22 | ☒ | 1<br>1<br>1<br>1 | GRAY, MOIST, PLASTIC, SILTY CLAY, [CL] SOME SAND, NO ODOR. |
| * S-12 (S2) | 2.8 | 22-24 | ☒ | 1<br>1<br>1<br>6 | |
| S-13 | 0 | 24-26 | ☒ | 9<br>21<br>34<br>42 | GRAY, WET VERY WELL SORTED, (POORLY GRADED) FINE-GRAINED, SILTY SAND, [SM], NO ODOR, WATER @ 24'. |
| S-14 | 0 | 26-28 | ☒ | 4<br>8<br>7<br>7 | SAME AS ABOVE, WET, NO ODOR. |
| S-15 | 0 | 28-30 | ☒ | 1<br>1<br>1<br>2 | SAME AS ABOVE, WET NO ODOR. |
| | | 30-32 | | | AUGERED TO 32' AND INSTALLED WELL. |
| | | 32-41 | | | * SAMPLES CHOSEN FOR LABORATORY ANALYSES. |



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| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER IANG-1-SB-9/MW8 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 11 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

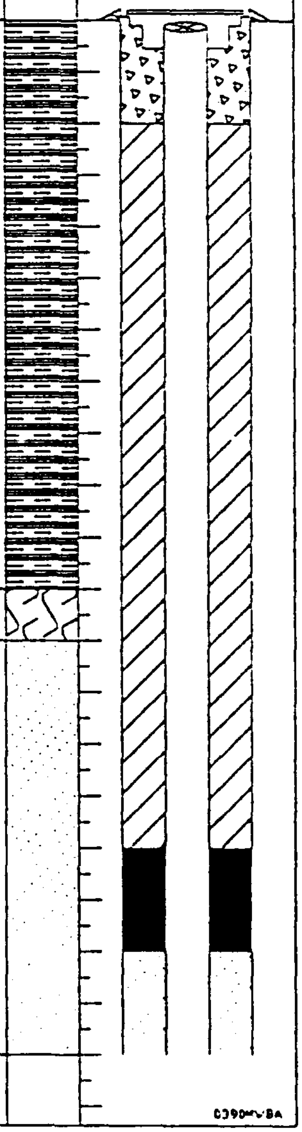
| | | | |
|---|---|---|---|
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-1 | 1 | 0<br>1 | | 3<br>4<br>7<br>7 | GRAY AND BROWN, DAMP, MED. PLAST, SILTY CLAY, [CL], NO ODOR, SOME ORGANICS (GRASS ROOTS). |
| S-2 | 2.3 | 2<br>3 | | 4<br>5<br>7<br>8 | SAME AS ABOVE, NO ODOR. |
| S-3 | 1.9 | 4<br>5 | | 4<br>5<br>7<br>11 | SAME AS ABOVE, NO ODOR. |
| S-4 | 1.5 | 6<br>7 | | 2<br>5<br>7<br>9 | SAME AS ABOVE, NO ODOR. |
| S-5 | 1.0 | 8<br>9 | | 3<br>6<br>9<br>11 | SAME AS ABOVE, NO ODOR. |
| S-6 | 0.5 | 10<br>11 | | 2<br>5<br>5<br>6 | BROWN AND GRAY, DAMP, SILT, [ML], SOME CLAY, NO ODOR. |
| S-7 | 10 | 12<br>13 | | 5<br>12<br>14<br>13 | BROWN, DAMP, VERY WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY SAND, [SM], NO ODOR. |
| S-8 | 11.4 | 14<br>15 | | 7<br>8<br>10<br>14 | SAME AS ABOVE, MOIST, NO ODOR. |
| * S-9 (S1) | 19 | 16<br>17 | | 9<br>11<br>16<br>18 | SAME AS ABOVE, DAMP, NO ODOR. |
| S-10 | 16 | 18<br>19 | | 8<br>18<br>28<br>28 | SAME AS ABOVE, NO ODOR. |
| | | 20<br>21 | | | CONTINUED ON PAGE 2 OF 2 |

LITHO. PROFILE

WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE FIGURE 3.3<br>ELEVATION | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 |
| | WELL NUMBER IANG-1-SB-9/MW-8 | LOCATION SITE 1 - DEFUELING PIT | |
| | DATE 11 AUGUST 1990 | WEATHER 80'S - SUNNY | |
| | LOCATED BY TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGER | SAMPLING METHOD SPLIT-SPOON | |
| | GRAVEL PACK SAND (30/70) | SEAL BENTONITE | |

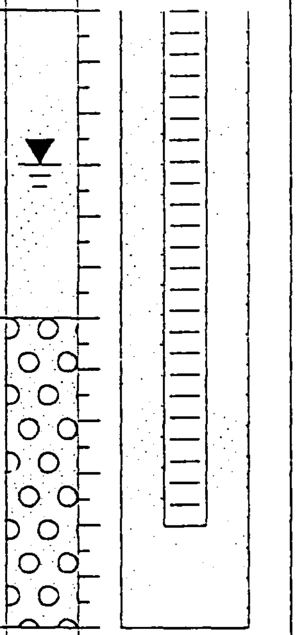
| | | | |
|---|---|---|---|
| CASING TYPE SCH. 40 PVC | DIAMETER 2" | LENGTH 20' | HOLE DIA. 9.75" |
| SCREEN TYPE SCH. 40 PVC SLOT 0.010" | DIAMETER 2" | LENGTH 10' | TOTAL DEPTH 32' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) |
|---|---|---|---|---|---|
| S-11<br>* (S2)<br>** (S2-D) | 23 | 21 | ☒ | 8<br>15<br>15<br>13 | BROWN, DAMP, VERY WELL SORTED (POORLY GRADED), FINE-GRAINED, SILTY <u>SAND</u>, [SM], NO ODOR. |
| S-12 | 10.9 | 23 | ☒ | 5<br>3<br>3<br>6 | SAME AS ABOVE, WATER @ 23', NO ODOR. |
| S-13 | 7.0 | 25 | ☒ | 2<br>3<br>8<br>8 | SAME AS ABOVE, WET, NO ODOR. |
| S-14 | 16.5 | 27 | ☒ | 1<br>3<br>3<br>6 | BROWN, WET, MODERATELY SORTED (POORLY GRADED), FINE TO COARSE GRAINED, SILTY <u>SAND</u> WITH GRAVEL, [SP], NO ODOR. |
| S-15 | 13.5 | 29 | ☒ | 3<br>3<br>5<br>6 | SAME AS ABOVE, NO ODOR. |
| | | 31 | | | AUGERED TO 32' AND INSTALLED WELL. |

* SAMPLES CHOSEN FOR LABORATORY ANALYSES.

** SAMPLES CHOSEN FOR DUPLICATE.

LITHO. PROFILE | WELL COMPLETION



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| | | | |
|---|---|---|---|
| LOCATION MAP | ENGINEERING-SCIENCE WELL LOG | PAGE 1 OF 1 | |
| | WELL NUMBER IANG-1-SB-2 | LOCATION SITE 1 - DEFUEL PIT | |
| | DATE 7 JULY 1990 | WEATHER 80'S - SUNNY | |
| | WELLSITE GEOLOGIST TAB/KMP | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD HOLLOW STEM AUGERS | SAMPLING METHOD SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK NA | SEAL BENTONITE | |
| CASING TYPE NA | DIAMETER NA | LENGTH NA | HOLE DIA. 9.75' |
| SCREEN TYPE NA SLOT NA | DIAMETER NA | LENGTH NA | TOTAL DEPTH 20' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) | LITHO. PROFILE | WELL COMPLETION |
|---|---|---|---|---|---|---|---|
| S-1 | 32.7 | 0<br>1 | ☒ | 1<br>2<br>4<br>6 | BROWN AND GREY, DAMP, PLASTIC, VERY WELL SORTED (POORLY GRADED), SILTY <u>CLAY</u>.<br>(CL), NO ODOR | | |
| S-2 | 43.4 | 2<br>3 | ☒ | 3<br>6<br>8<br>10 | SAME AS ABOVE | | |
| S-3 | 75 | 4<br>5 | ☒ | 2<br>4<br>6<br>8 | SAME AS ABOVE | | |
| S-4 | 53 | 6<br>7 | ☒ | 3<br>4<br>6<br>8 | SAME AS ABOVE | | |
| S-5 | 45 | 8<br>9 | ☒ | 2<br>2<br>4<br>4 | SAME AS ABOVE, HYDROCARBON ODOR (H-C) | | |
| S-6 | 208 | 10<br>11 | ☒ | 1<br>2<br>3<br>4 | | | |
| S-7 | 844 | 12<br>13 | ☒ | 2<br>2<br>2<br>9 | BROWN AND GREY, DAMP, NONPLASTIC, WELL SORTED, <u>SILT</u> (H-C) ODOR, INTERBEDS OF DAMP, FINE GRAINED SILTY SAND.<br>BROWN AND GREY, NONPLASTIC, WELL SORTED, FINE GRAINED, SILTY <u>SAND</u>, (H-C) ODOR | | |
| S-8 | 3409 | 14<br>15 | ☒ | 9<br>16<br>16<br>20 | SAME AS ABOVE | | |
| S-9 | 3410 | 16<br>17 | ☒ | 10<br>20<br>31<br>37 | SAME AS ABOVE | | |
| S-10 | 3811 | 18<br>19 | ☒ | 8<br>9<br>13<br>15 | SAME AS ABOVE | | |
| | | 20<br>21 | | | ABANDONED BORING AS PER HAZWRAP REQUEST.<br>0930 1 AUG 1990 T. BENSON | | |

0390582 LB

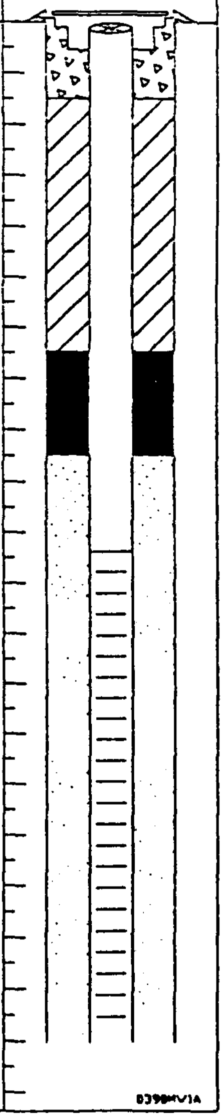
| | | | |
|---|---|---|---|
| LOCATION MAP<br>SEE SITE PLAN | ENGINEERING-SCIENCE WELL LOG | | PAGE 1 OF 2 |
| | WELL NUMBER B1/MW-1 | LOCATION IOWA ANG UST ASS. | |
| | DATE 12-12-90 | WEATHER CLOUDY, 30'S | |
| | WELLSITE GEOLOGIST K. PALOMBO | DRILLED BY FOX DRILLING | |
| | DRILLING METHOD 6.25' ID HOLLOW STEM AUGS | SAMPLING METHOD 2' SPLIT-SPOON | |
| ELEVATION | GRAVEL PACK 20-40 SILICA SAND | SEAL BENTONITE | |

| | | | | |
|---|---|---|---|---|
| CASING TYPE SCH 40 PVC | | DIAMETER 4' | LENGTH 10.3' | HOLE DIA. 10' |
| SCREEN TYPE SCH 40 PVC | SLOT 0.010' | DIAMETER 4' | LENGTH 15' | TOTAL DEPTH 26' |

| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) | LITHO. PROFILE |
|---|---|---|---|---|---|---|
| | | 0 | | | ASPHALT | |
| | | 1<br>2 | | | BROWN FINE SAND | |
| | | 3<br>4 | | | DARK GRAY CLAY | |
| 1 | 50 | 5<br>6 | | 4<br>9<br>9<br>12 | MEDIUM BROWN MOTTLED GRAY CLAY WITH TRACE SILT FEW REDDISH BROWN ROOT TRAILS. | |
| | | 7<br>8 | | | | |
| | | 9 | | | BROWN FINE SAND WITH A TRACE OF SILT. | |
| 2 | 10 | 10<br>11 | | 2<br>1<br>1<br>2 | | |
| | | 12<br>13<br>14 | | | BROWN CLAY WITH MINOR SILT. | |
| 3 | 17 | 15<br>16 | | 1<br>2<br>4<br>3 | WET, GRAY MOTTLED REDDISH BROWN FINE SILTY SAND WITH FEW REDDISH BROWN ROOTLETS. | |
| | | 17<br>18<br>19 | | | | |
| 4 | 14.5 | 20<br>21 | | 1<br>1 | SOFT, MOIST GRAY CLAY | |

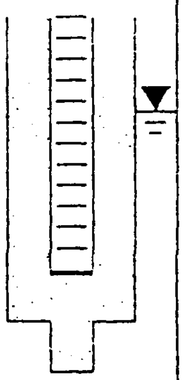
WELL COMPLETION

FLUSH MOUNT PROTECTIVE COVER



| LOCATION MAP | ENGINEERING-SCIENCE WELL LOG | | PAGE 2 OF 2 | |
|---|---|---|---|---|
| SEE SITE PLAN | WELL NUMBER | B1/MW-1 | LOCATION | IOWA ANG UST ASS. |
| | DATE | 12-12-90 | WEATHER | CLOUDY, 30'S |
| | WELLSITE GEOLOGIST | K. PALOMBO | DRILLED BY | FOX DRILLING |
| | DRILLING METHOD | 6.25" ID HOLLOW STEM AUGST | SAMPLING METHOD | 2' SPLIT-SPOON |
| ELEVATION | GRAVEL PACK | 20-40 SILICA SAND | SEAL | BENTONITE |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CASING TYPE | SCH 40 PVC | | DIAMETER | 4" | LENGTH | 10.3' | HOLE DIA. 10" |
| SCREEN TYPE | SCH 40 PVC | SLOT 0.010" | DIAMETER | 4" | LENGTH | 15' | TOTAL DEPTH 26' |



| SAMPLE NO. | ORGANIC VAPORS (PPM) | DEPTH | SAMPLE RECOVERY | PENETRATION RESISTANCE | DESCRIPTION/REMARKS (COLOR, MOISTURE, PLASTICITY, SORTING, SOIL TYPE, ODOR.) | LITHO. PROFILE | WELL COMPLETION |
|---|---|---|---|---|---|---|---|
| | | 20 | | | | | |
| | | 21 | ■ | 1<br>1 | SOFT MOIST GRAY CLAY. | | |
| | | 22 | | | | | |
| | | 23 | | | | | |
| | | 24 | | | WET, DARK GRAY FINE TO MEDIUM SAND (60-70% QUARTZ SAND) | | |
| | | 25 | ■ | 1<br>7 | | | |
| 5 | 8.5 | 26 | ■ | 8<br>6 | | | |
| | | 27 | | | | | |
| | | 28 | | | | | |
| | | 29 | | | | | |
| | | 30 | | | | | |
| | | 31 | | | | | |
| | | 32 | | | | | |
| | | 33 | | | | | |
| | | 34 | | | | | |
| | | 35 | | | | | |
| | | 36 | | | | | |
| | | 37 | | | | | |
| | | 38 | | | | | |
| | | 39 | | | | | |
| | | 40 | | | | | |
| | | 41 | | | | | |

0390MW18

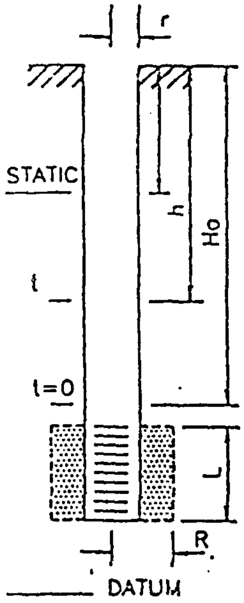
# APPENDIX F

# HYDRAULIC CONDUCTIVITY TEST RESULTS

# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER MW-2 (Test)
DATE 8-22-90

LOCATION Site 1 - Defueling Ar—
ELEVATION



STATIC HEAD 25.00
PIPE RADIUS (r) .083
BORE HOLE RADIUS (R) .417
SATURATED SCREEN LENGTH (L) 5.5

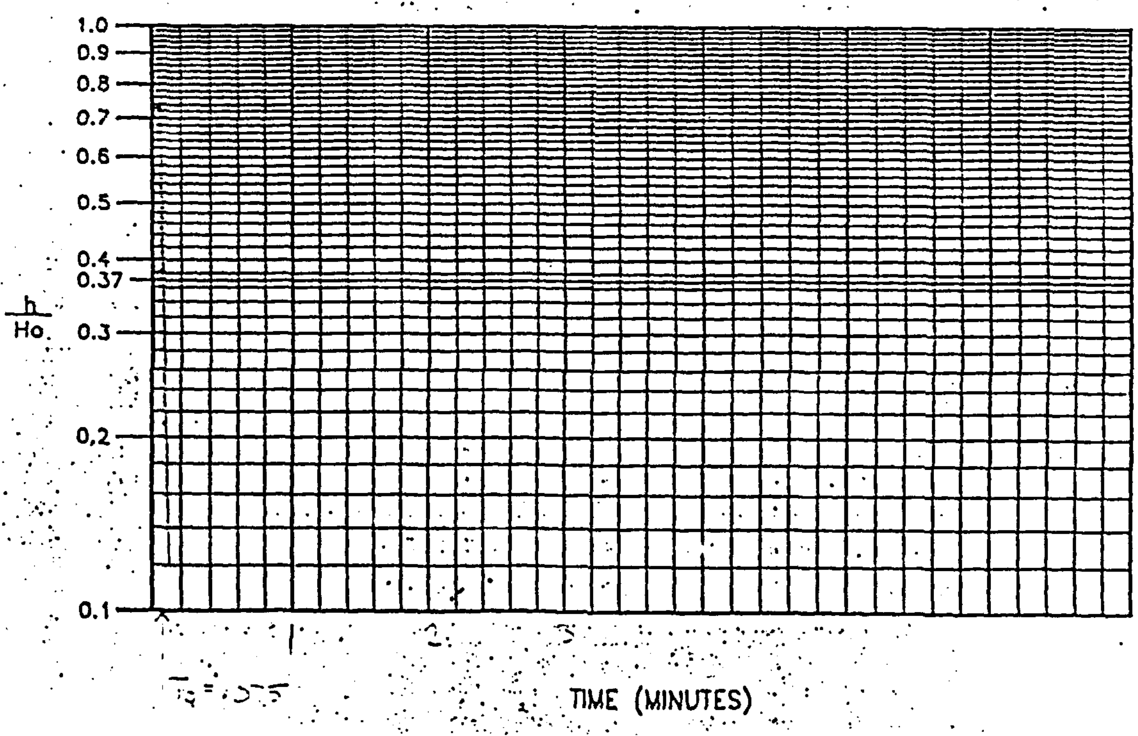
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2 \ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2 \ln.(5.5/.417)}{2(5.5)(.075)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.00 | —— | | —— |
| 00 | 26.67 | 1.67 | (Ho) | 1.00 |
| .02 | 26.22 | 1.22 | (h) | .73 |
| .03 | 25.89 | .89 | (h) | .53 |
| .05 | 25.64 | .64 | (h) | .38 |
| .07 | 25.47 | .47 | (h) | .28 |
| .08 | 25.35 | .35 | (h) | .21 |
| .10 | 25.26 | .26 | (h) | .16 |
| .12 | 25.20 | .20 | (h) | .12 |
| .13 | 25.15 | .15 | (h) | .09 |
| .15 | 25.12 | .12 | (h) | .07 |
| .17 | 25.10 | .10 | (h) | .06 |
| .25 | 25.04 | .04 | (h) | .02 |
| .33 | 25.03 | .03 | (h) | .02 |
| .42 | 25.01 | .01 | (h) | |

K= .222 FT/MIN K= 31.68 FT/DAY K= $1.1 \times 10^{-2}$ CM/SEC



# HVORSLEV'S METHOD FOR K

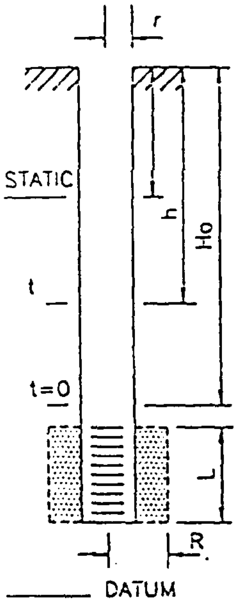
PROJECT *Iowa AAP*

WELL NUMBER *MW-5* [illegible]

DATE *8/22/90*

LOCATION *Site 1 - Defueling Pit*

ELEVATION



STATIC HEAD *24.54*

PIPE RADIUS (r) *.083*

BORE HOLE RADIUS (R) *.417*

SATURATED SCREEN LENGTH (L) *6.0*

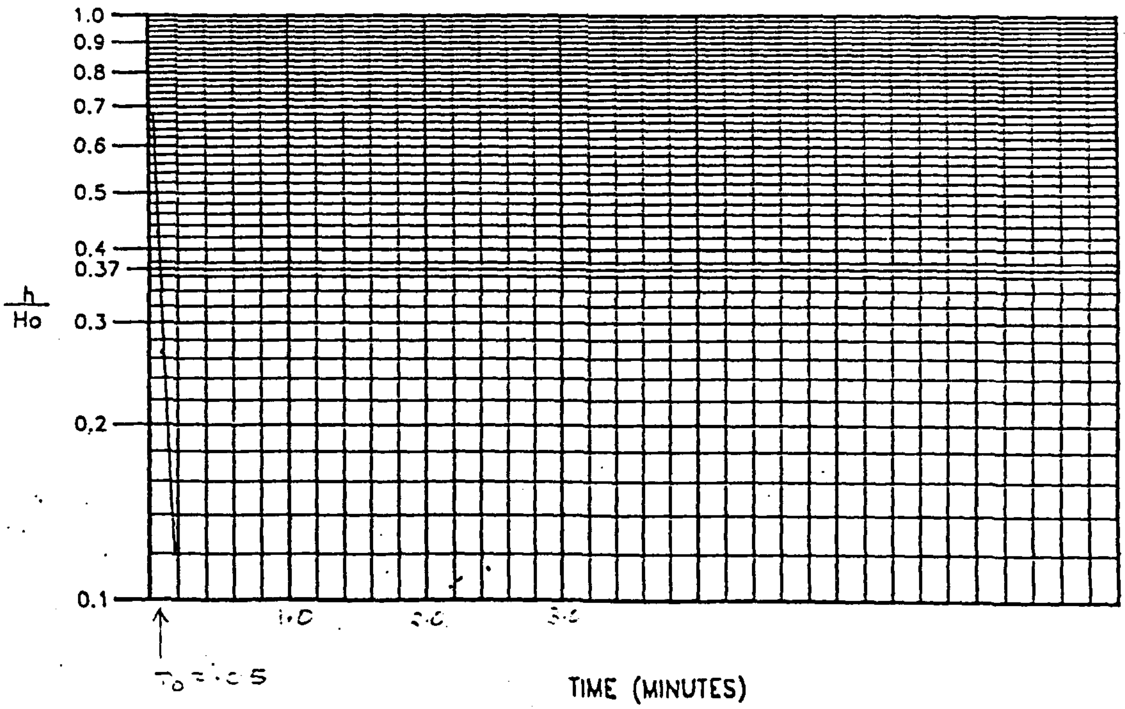
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LTo}$$

$$K=\frac{(.083)^2\ln(6/.417)}{2(6)(.05)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | *24.54* | — | | — |
| 00 | [illegible] | *1.17* | (Ho) | 1.00 |
| *.02* | [illegible] | *.75* | (h) | *.64* |
| [illegible] | *25.04* | [illegible] | (h) | *.43* |
| [illegible] | [illegible] | [illegible] | (h) | *.27* |
| [illegible] | [illegible] | *.22* | (h) | *.19* |
| [illegible] | *24.69* | *.15* | (h) | *.13* |
| [illegible] | [illegible] | [illegible] | (h) | [illegible] |
| [illegible] | [illegible] | [illegible] | (h) | *.07* |
| *.13* | [illegible] | *.06* | (h) | *.05* |
| *.15* | [illegible] | [illegible] | (h) | *.04* |
| *.17* | [illegible] | *.04* | (h) | *.03* |
| *.18* | [illegible] | *.03* | (h) | *.02* |
| [illegible] | *24.55* | *.01* | (h) | *.01* |
| [illegible] | *24.54* | [illegible] | (h) | *0* |

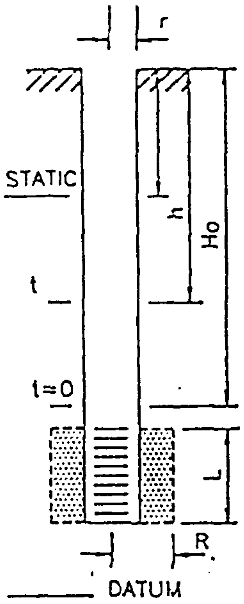
K= *.031* FT/MIN K= *44.64* FT/DAY K= *$1.57\times10^{-2}$* CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa AAP
WELL NUMBER MW-5([illegible])
DATE 8/22/90

LOCATION Site 1-D [illegible]
ELEVATION



STATIC HEAD 24.54

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 6.0

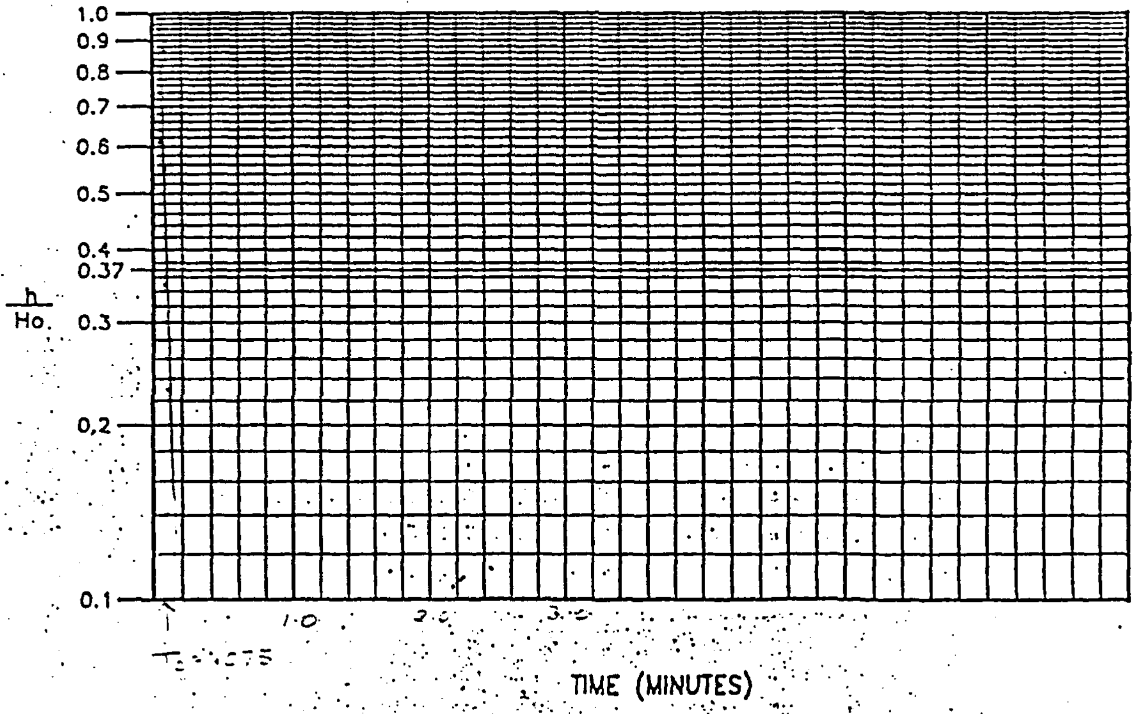
HYDRAULIC CONDUCTIVITY:

$$K = \frac{r^2 \ln(L/R)}{2LT_o}$$

$$K = \frac{(.083)^2 \ln(6/.417)}{2(6)(.075)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 24.54 | — | | — |
| 00 | 25.59 | [illegible] | (Ho) | 1.00 |
| [illegible] | [illegible] | [illegible] | (h) | .91 |
| .03 | [illegible] | .72 | (h) | [illegible] |
| [illegible] | [illegible] | [illegible] | (h) | [illegible] |
| 07 | 25.12 | .58 | (h) | .55 |
| .08 | 24.91 | .37 | (h) | .35 |
| .10 | 24.78 | .24 | (h) | .23 |
| .12 | [illegible] | [illegible] | (h) | [illegible] |
| .13 | 24.63 | .09 | (h) | .09 |
| .15 | 24.60 | .06 | (h) | .06 |
| .22 | [illegible] | 0 | (h) | 0 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

K= .020 FT/MIN K= 29.4 FT/DAY K= $1.04 \times 10^{-2}$ CM/SEC

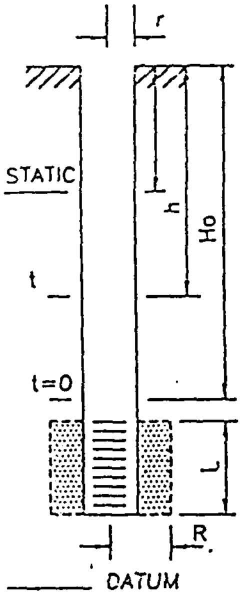


HVRSLDE

# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER MW-7 (T[illegible])
DATE 5/22/90

LOCATION Site 1 - Defueling Pit
ELEVATION ______



STATIC HEAD 24.41
PIPE RADIUS (r) .083
BORE HOLE RADIUS (R) .417
SATURATED SCREEN LENGTH (L) 6.0

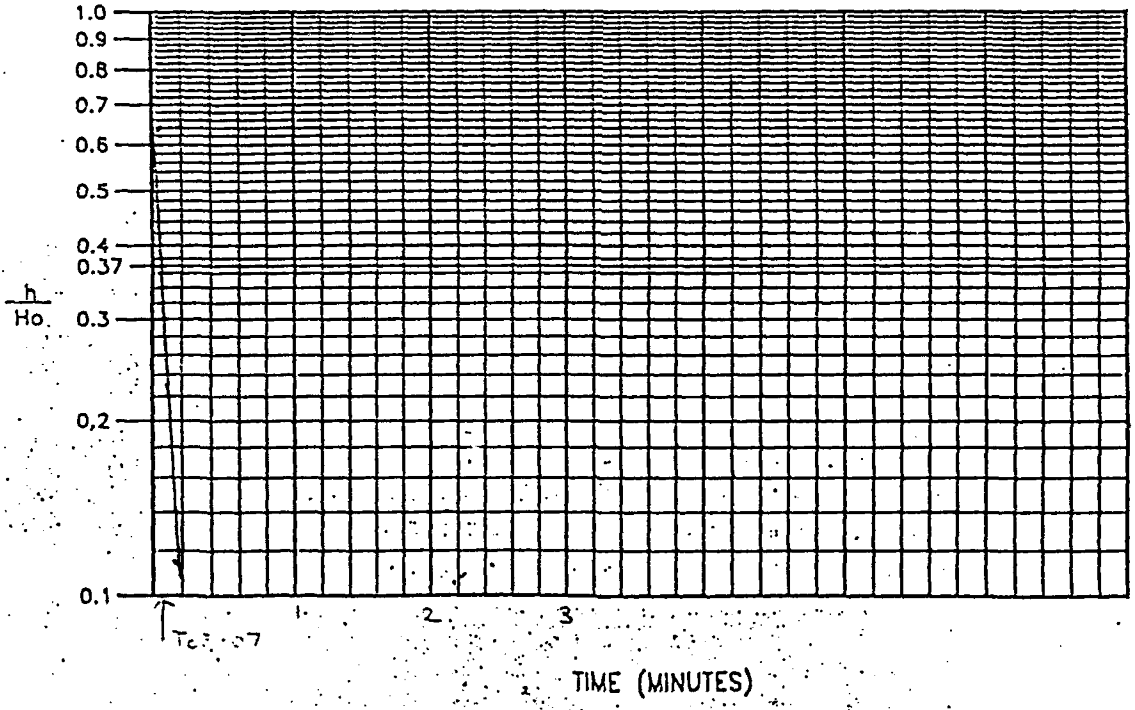
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2 \ln(6./.417)}{2(6)(.07)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{H_o}$ |
|---|---|---|---|---|
| STATIC | 24.41 | ——— | | — |
| 00 | 26.03 | 1.62 | (Ho) | 1.00 |
| .03 | 25.44 | 1.03 | (h) | .64 |
| .07 | 25.03 | .62 | (h) | .38 |
| .10 | 24.77 | .36 | (h) | .22 |
| .13 | 24.65 | .24 | (h) | .15 |
| .17 | 24.59 | .18 | (h) | .11 |
| .33 | 24.44 | .03 | (h) | .02 |
| .50 | 24.42 | .01 | (h) | [illegible] |
| .66 | 24.41 | .0 | (h) | -- |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

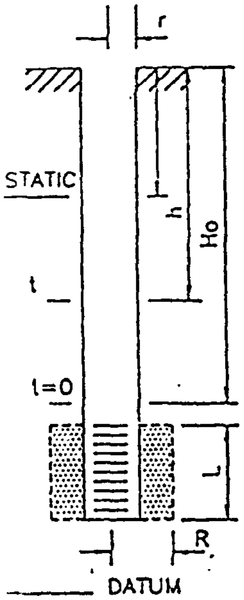
K= .022 FT/MIN K= 31.68 FT/DAY K= 1.1 x10⁻² CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER MW-7 (Test 2)
DATE 5/22/93

LOCATION Site 1 Defueling PIT
ELEVATION



STATIC HEAD 24.41
PIPE RADIUS (r) .083
BORE HOLE RADIUS (R) .417
SATURATED SCREEN LENGTH (L) 6.0

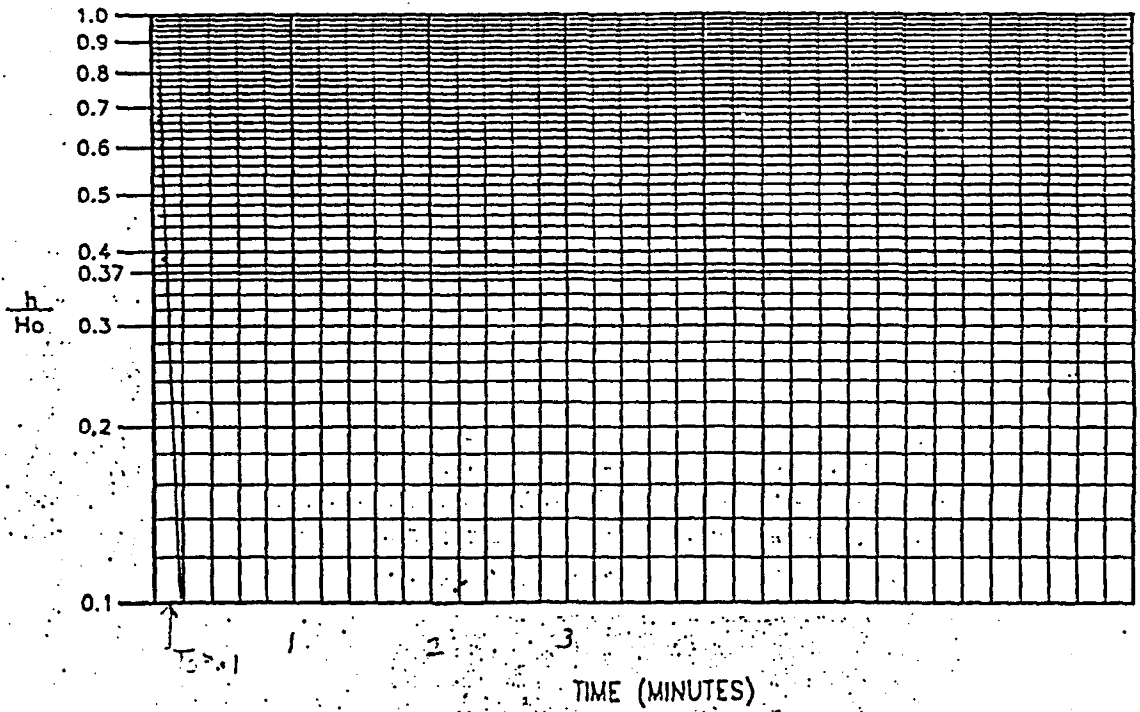
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LTo}$$

$$K=\frac{(.083)^2(6/.417)}{2(6)(.1)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 24.41 | —— | | — |
| 00 | 26.28 | 1.87 | (Ho) | 1.00 |
| .03 | 25.66 | 1.25 | (h) | .67 |
| .07 | 25.15 | .74 | (h) | .39 |
| .10 | 24.86 | .45 | (h) | .24 |
| .13 | 24.65 | .27 | (h) | .14 |
| .23 | 24.51 | .10 | (h) | .05 |
| .40 | 24.42 | .01 | (h) | — |
| .5 | 24.41 | 0 | (h) | — |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

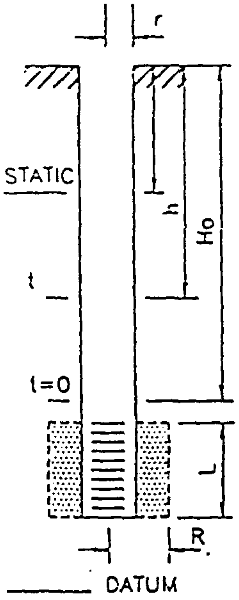
K= .015 FT/MIN K= 22. FT/DAY K= 7.8x10$^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT [illegible]
WELL NUMBER [illegible])
DATE [illegible]

LOCATION [illegible]
ELEVATION



STATIC HEAD 22.70'
PIPE RADIUS (r) .053'
BORE HOLE RADIUS (R) .417'
SATURATED SCREEN LENGTH (L) 7.0

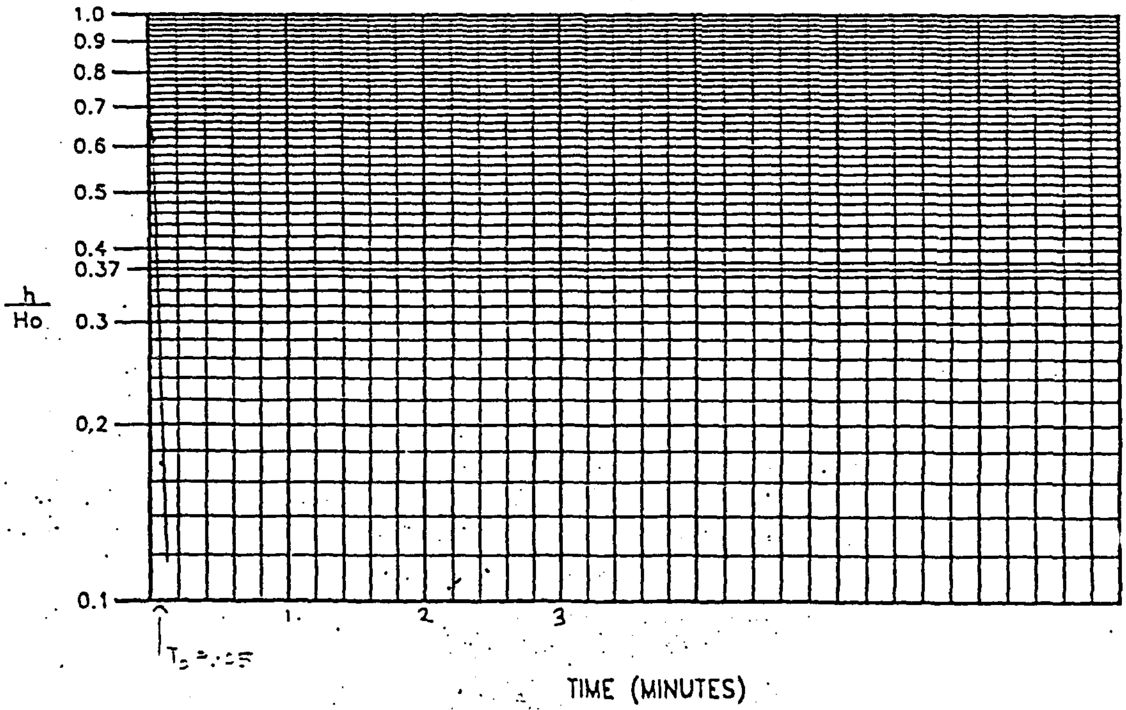
HYDRAULIC CONDUCTIVITY:

$$K = \frac{r^2 \ln(L/R)}{2LTo}$$

$$K = \frac{(.053)^2 \ln(7/.417)}{2(7)(.057)}$$

K= .025 FT/MIN K= 39.77 FT/DAY K= 1.4/x10$^{-2}$ CM/SEC

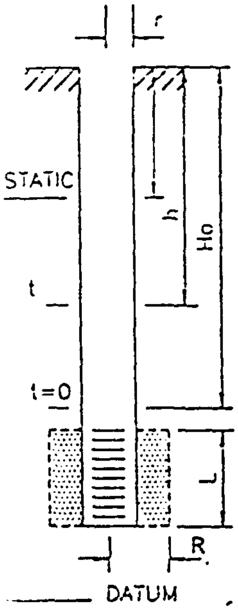
| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 22.70 | ———— | | — |
| 00 | 23.59 | .59 | (Ho) | 1.00 |
| [illegible] | 23.24 | .54 | (h) | .61 |
| .07 | 22.85 | .15 | (h) | [illegible] |
| .10 | 22.75 | .05 | (h) | .06 |
| .13 | 22.72 | .02 | (h) | .02 |
| [illegible] | 22.70 | 0 | (h) | — |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |



HvsBLDG

# HVORSLEV'S METHOD FOR K

PROJECT [illegible]
LOCATION Site 2 [illegible]
WELL NUMBER TW-1 [illegible]
ELEVATION
DATE 9-21-90



STATIC HEAD 26.

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 4.0

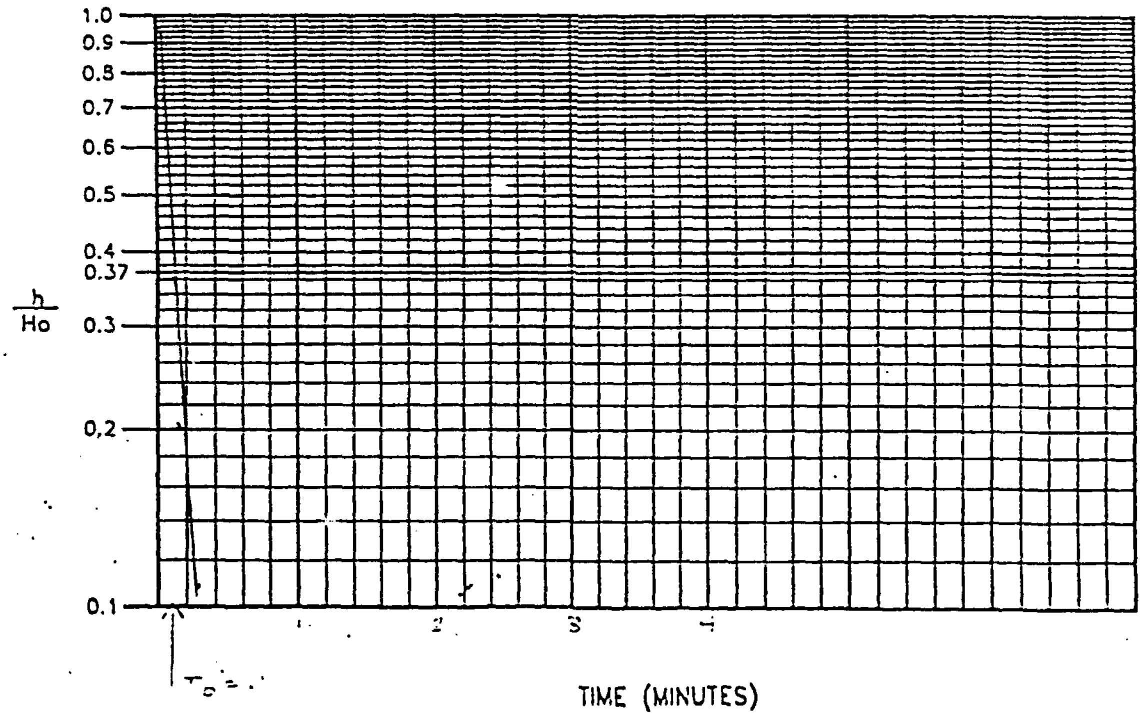
HYDRAULIC CONDUCTIVITY:

$$K = \frac{r^2 \ln(L/R)}{2LT_o}$$

$$K = \frac{(.083)^2 \ln(4/.417)}{2(4)(.1)}$$

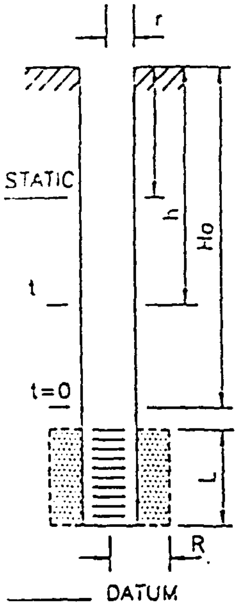
| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 26.00 | ———— | | — |
| 00 | 27.74 | 1.79 | (Ho) | 1.00 |
| .03 | 27.30 | 1.30 | (h) | .73 |
| [illegible] | 26.65 | .65 | (h) | .36 |
| .20 | 26.32 | .32 | (h) | .19 |
| .28 | 26.22 | .22 | (h) | .12 |
| .45 | 26.10 | .10 | (h) | .06 |
| .70 | 26.05 | .05 | (h) | .03 |
| [illegible] | 26.03 | .03 | (h) | .02 |
| 1.7[illegible] | 26.02 | .02 | (h) | .01 |
| 3.2 | 26.01 | .01 | (h) | .005 |
| 5.2 | 26.00 | 0 | (h) | 0 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

K= 1.9 x 10$^{-2}$ FT/MIN K= 27 FT/DAY K= 9.65 x 10$^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT [illegible]
WELL NUMBER [illegible] ([illegible] 3)
DATE [illegible]
LOCATION [illegible]
ELEVATION



STATIC HEAD [illegible]

PIPE RADIUS (r) .055'

BORE HOLE RADIUS (R) .417'

SATURATED SCREEN LENGTH (L) 4.0

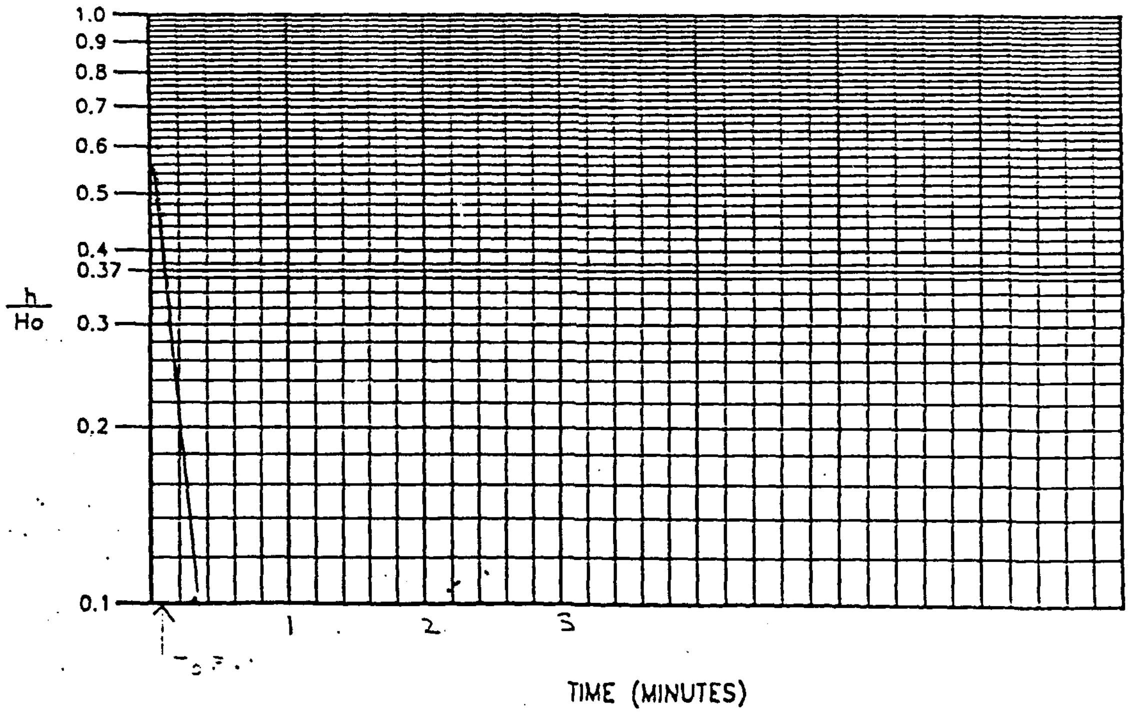
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{[illegible]\ \ln(4/.417)}{2(4)(.1)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 26.00 | — | | — |
| 00 | 27.64 | 1.64 | (Ho) | 1.00 |
| .07 | 27.00 | 1.00 | (h) | .61 |
| .12 | 26.75 | .75 | (h) | .46 |
| .15 | [illegible] | .43 | (h) | .26 |
| .32 | [illegible] | .17 | (h) | .10 |
| .73 | 26.05 | .05 | (h) | .03 |
| [illegible] | 26.03 | .03 | (h) | .02 |
| 3.32 | [illegible] | 0 | (h) | 0 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

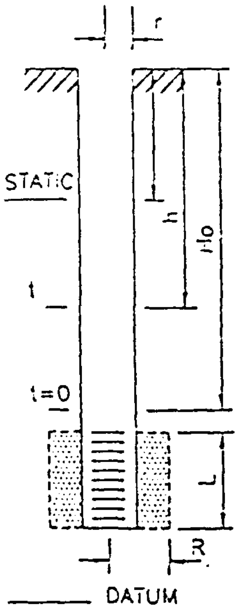
K= .0194 FT/MIN K= 28.03 FT/DAY K= $9.89\times10^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER TW-2 ([illegible])
DATE 9/21/90

LOCATION Site 2 - [illegible]
ELEVATION



STATIC HEAD 25.89

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 5.0

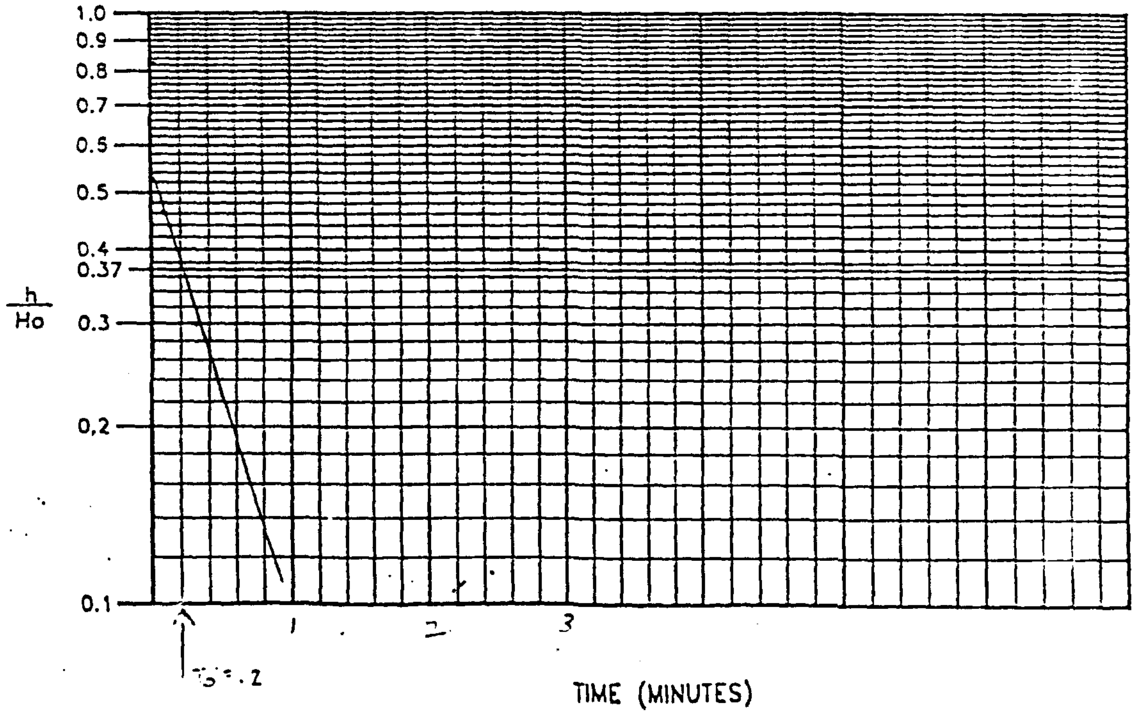
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2\ln(5/.417)}{2(5)(.20)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.89 | ——— | | — |
| 00 | 27.89 | 2.0 | (Ho) | 1.00 |
| .03 | 27.55 | 1.66 | (h) | .83 |
| .13 | 26.80 | .91 | (h) | .46 |
| .30 | 26.48 | .59 | (h) | .30 |
| .47 | 26.03 | .14 | (h) | .07 |
| .63 | 25.98 | .09 | (h) | .05 |
| .80 | 25.96 | .07 | (h) | .04 |
| .97 | 25.95 | .06 | (h) | .03 |
| 1.13 | 25.94 | .05 | (h) | .03 |
| 1.53 | 25.93 | .04 | (h) | .02 |
| 2.02 | 25.92 | .03 | (h) | .02 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

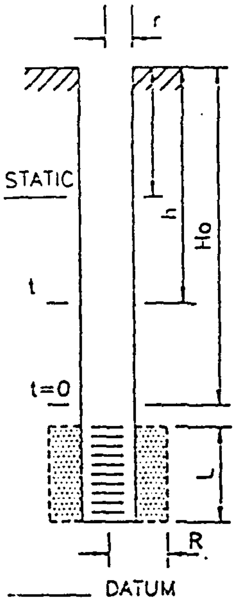
K= .0085 FT/MIN K= 12.32 FT/DAY K= $4.34 \times 10^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER TW-2 [illegible]
DATE 8/[illegible]/90

LOCATION Site 2 – Pet. Res. Site
ELEVATION



STATIC HEAD 25.88

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) [illegible]

SATURATED SCREEN LENGTH (L) 5.0

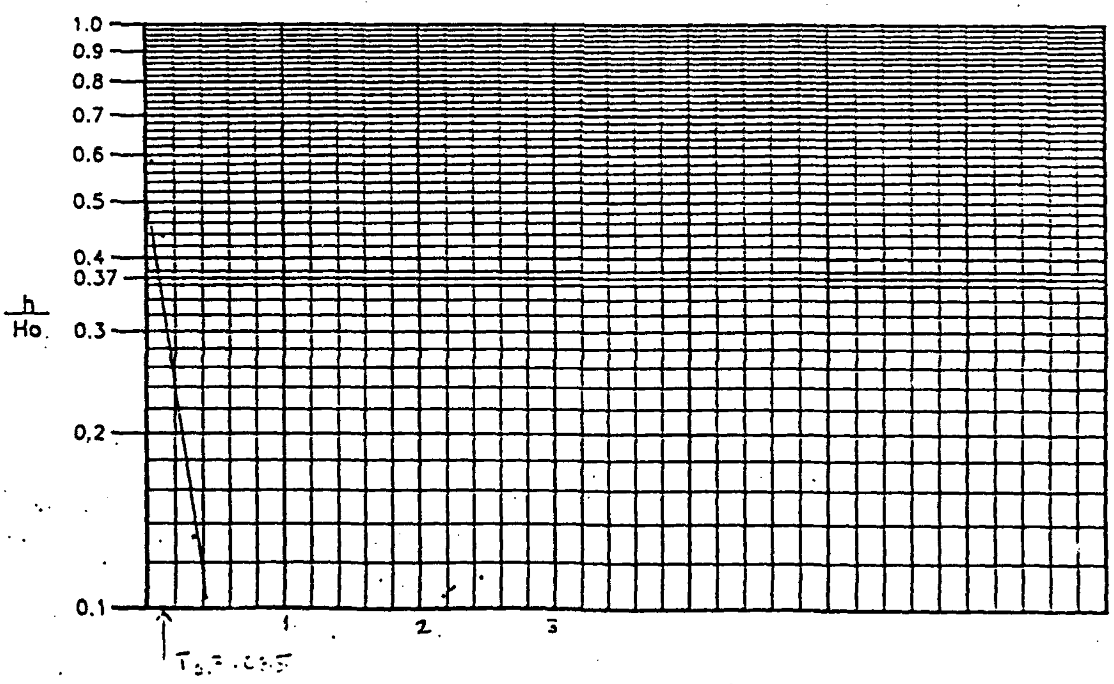
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2\ln(5/.417)}{2(5)(.085)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH–STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.88 | —— | | — |
| 00 | 27.05 | 1.17 | (Ho) | 1.00 |
| .05 | 26.57 | .69 | (h) | .59 |
| .1 | 26.39 | .51 | (h) | .44 |
| .15 | 26.26 | .38 | (h) | .32 |
| .35 | 26.03 | .15 | (h) | .13 |
| [illegible] | 25.93 | .05 | (h) | .04 |
| [illegible] | 25.92 | .04 | (h) | .03 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

K= .020 FT/MIN  K= 28.99 FT/DAY  K= $1.02\times10^{-2}$ CM/SEC

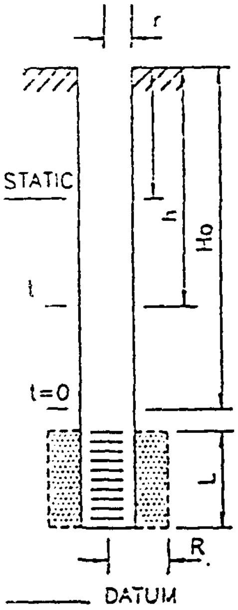


TIME (MINUTES)

# HVORSLEV'S METHOD FOR K

PROJECT [illegible]
WELL NUMBER TW-3
DATE 9/21/90

LOCATION Site 2 · [illegible]
ELEVATION ______



STATIC HEAD 25.29
PIPE RADIUS (r) .083
BORE HOLE RADIUS (R) .417
SATURATED SCREEN LENGTH (L) 5.0

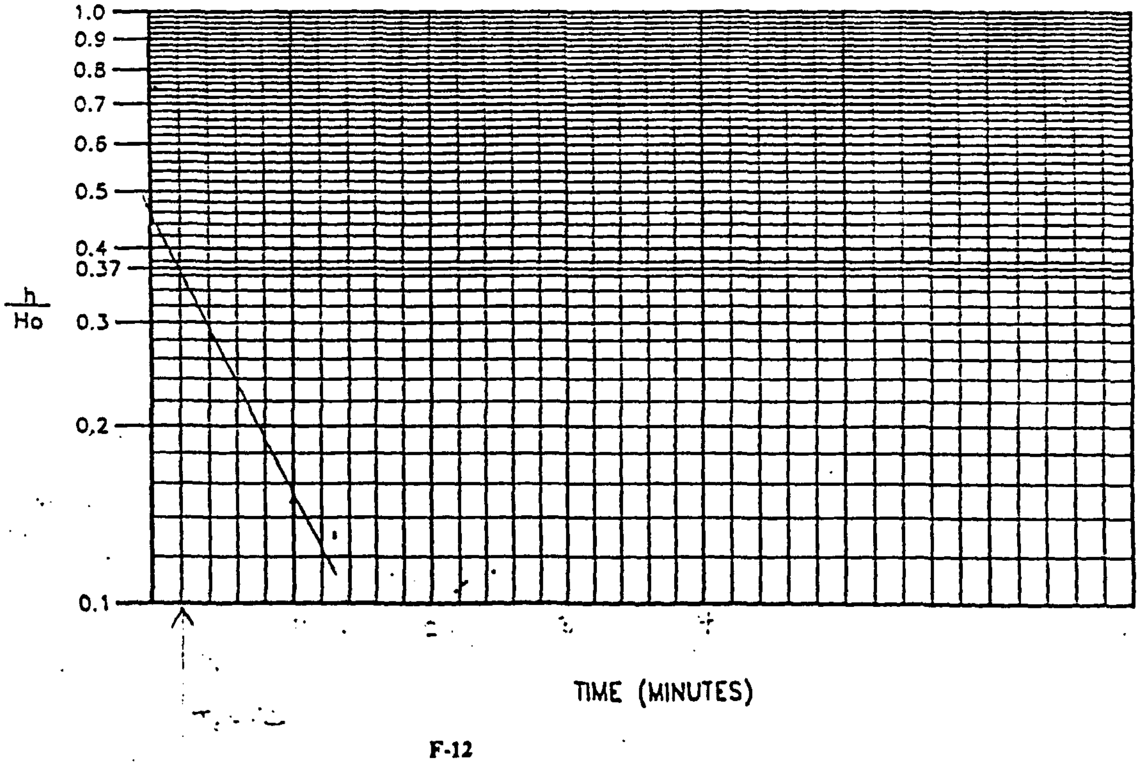
HYDRAULIC CONDUCTIVITY:

$$K = \frac{r^2 \ln(L/R)}{2LT_o}$$

$$K = \frac{(.083)^2 \ln(5/.417)}{2(5)(.2)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.29 | — | | — |
| 00 | 27.68 | 2.39 | (Ho) | 1.00 |
| .25 | 27.09 | 1.80 | (h) | .75 |
| .5 | 26.33 | 1.04 | (h) | .44 |
| .41 | 25.97 | .68 | (h) | .28 |
| .75 | 25.79 | .50 | (h) | .21 |
| 1 | 25.65 | .36 | (h) | .15 |
| 1.25 | 25.61 | .32 | (h) | .13 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

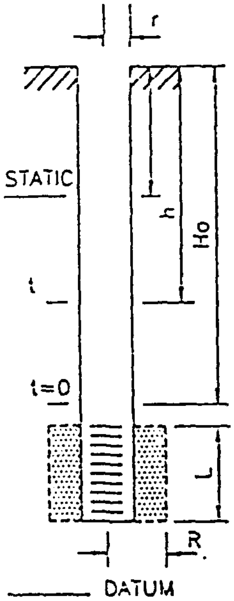
K= $8.55 \times 10^{-3}$ FT/MIN K= 12.24 FT/DAY K= $4.32 \times 10^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT [illegible]
WELL NUMBER TW-4
DATE [illegible]

LOCATION Site 2 - [illegible] Site
ELEVATION



STATIC HEAD 25.48

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 6.5'

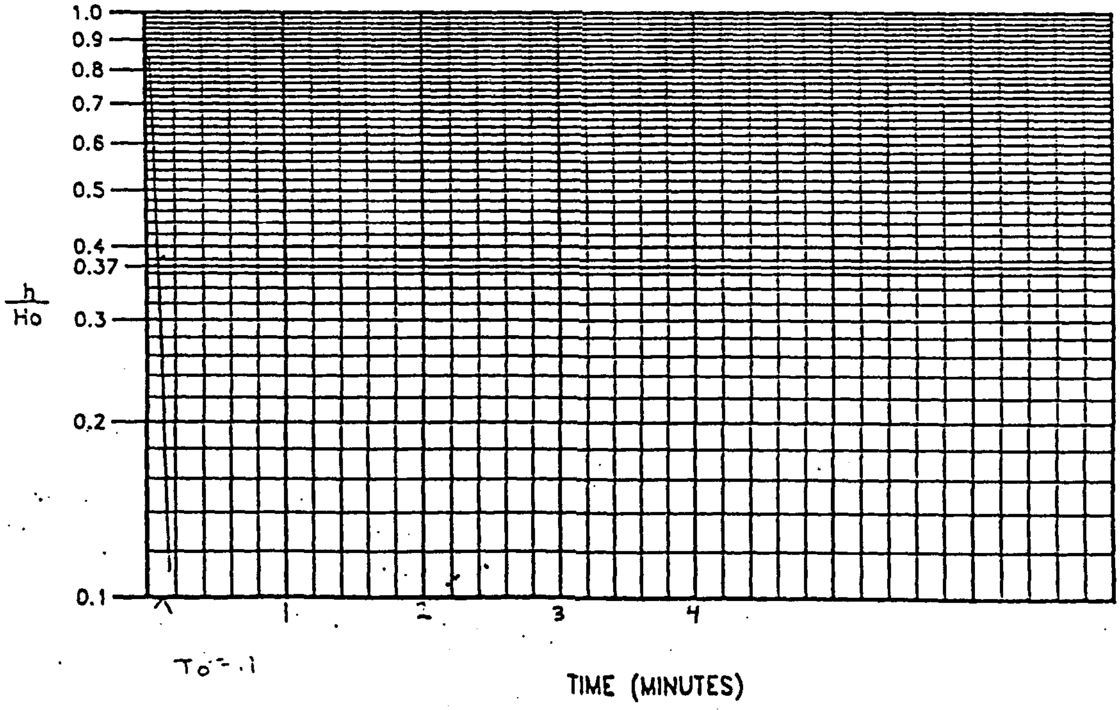
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2\ln(6.5/.41)}{2(6.5)(.1)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.48 | — | | — |
| 00 | 27.21 | 1.73 | (Ho) | 1.00 |
| .07 | 26.43 | .95 | (h) | .55 |
| .10 | 26.14 | .66 | (h) | .38 |
| .15 | 25.76 | .28 | (h) | .16 |
| .27 | 25.64 | .16 | (h) | .09 |
| .52 | 25.56 | .08 | (h) | .05 |
| .77 | 25.55 | .07 | (h) | .04 |
| 1.27 | 25.53 | .05 | (h) | .03 |
| 1.52 | 25.53 | .05 | (h) | .03 |
| 2.27 | 25.50 | .02 | (h) | .01 |
| 2.77 | 25.48 | 0 | (h) | 0 |
| | | | (h) | |
| | | | (h) | |
| | | | (h) | |

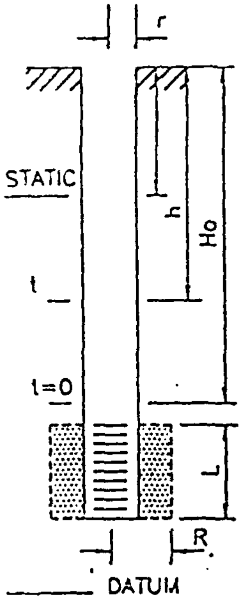
K= .0146 FT/MIN K= 21.03 FT/DAY K= $7.4\times10^{-3}$ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa AAP
WELL NUMBER TW-5 (Test 1)
DATE 8/21/90

LOCATION Site 2 - [illegible] Site
ELEVATION



STATIC HEAD 25.94

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 5.5'

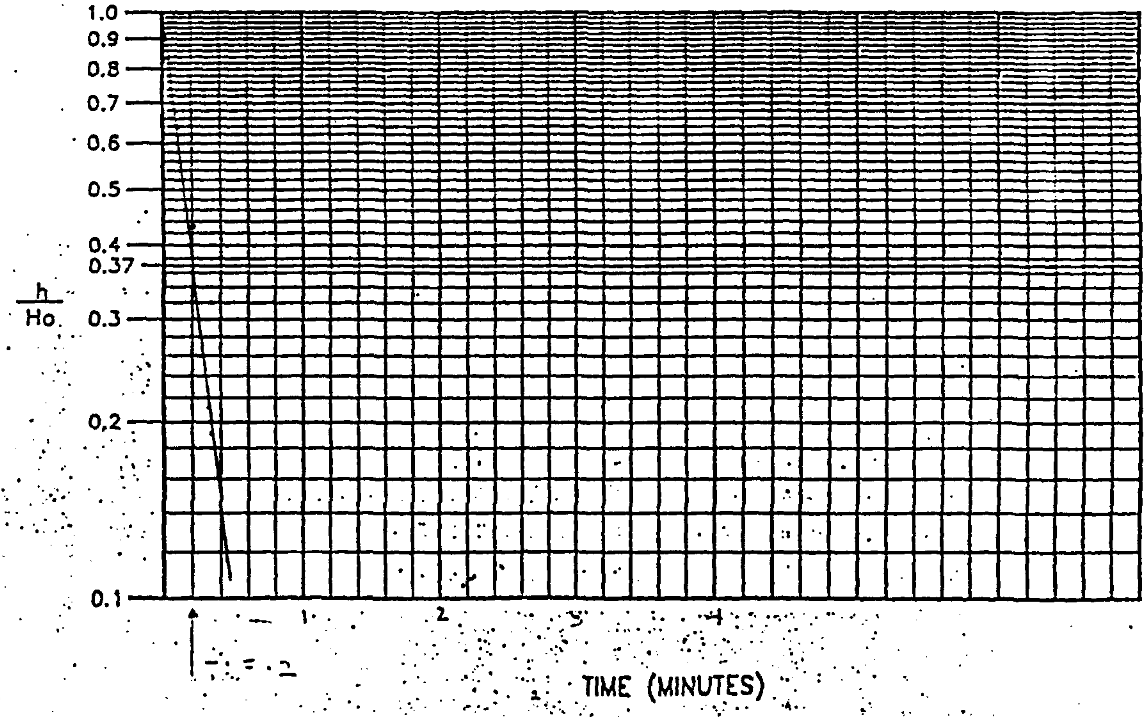
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LT_o}$$

$$K=\frac{(.083)^2\ln(5.5/.417)}{2(5.5)(.2)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.94 | — | | — |
| 00 | 27.85 | 1.91 | (Ho) | 1.00 |
| .03 | 27.52 | 1.58 | (h) | .83 |
| .07 | 27.33 | 1.39 | (h) | .73 |
| .10 | 27.07 | 1.13 | (h) | .59 |
| .13 | 26.99 | 1.05 | (h) | .55 |
| .17 | 26.85 | .91 | (h) | .48 |
| .20 | [illegible] | .82 | (h) | .43 |
| .37 | [illegible] | .36 | (h) | .19 |
| .53 | 26.11 | .17 | (h) | .09 |
| .70 | 26.04 | .10 | (h) | .05 |
| .87 | 26.00 | .06 | (h) | .03 |
| 1.03 | 25.98 | .04 | (h) | .02 |
| 1.20 | 25.96 | .02 | (h) | .01 |
| 1.37 | 25.94 | .00 | (h) | 0 |

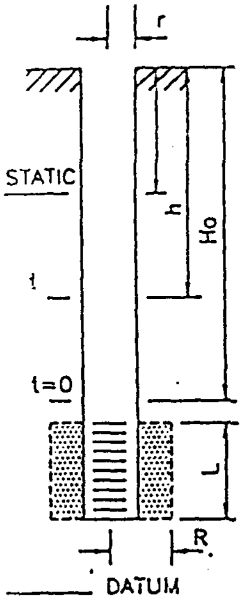
K= .0021 FT/MIN K= 11.66 FT/DAY K= 4.1×10⁻³ CM/SEC



# HVORSLEV'S METHOD FOR K

PROJECT Iowa ANG
WELL NUMBER TW-5 (Test 2)
DATE 3/21/90

LOCATION Site 2 - Pet. Rad. Site
ELEVATION



STATIC HEAD 25.84

PIPE RADIUS (r) .083

BORE HOLE RADIUS (R) .417

SATURATED SCREEN LENGTH (L) 5.5

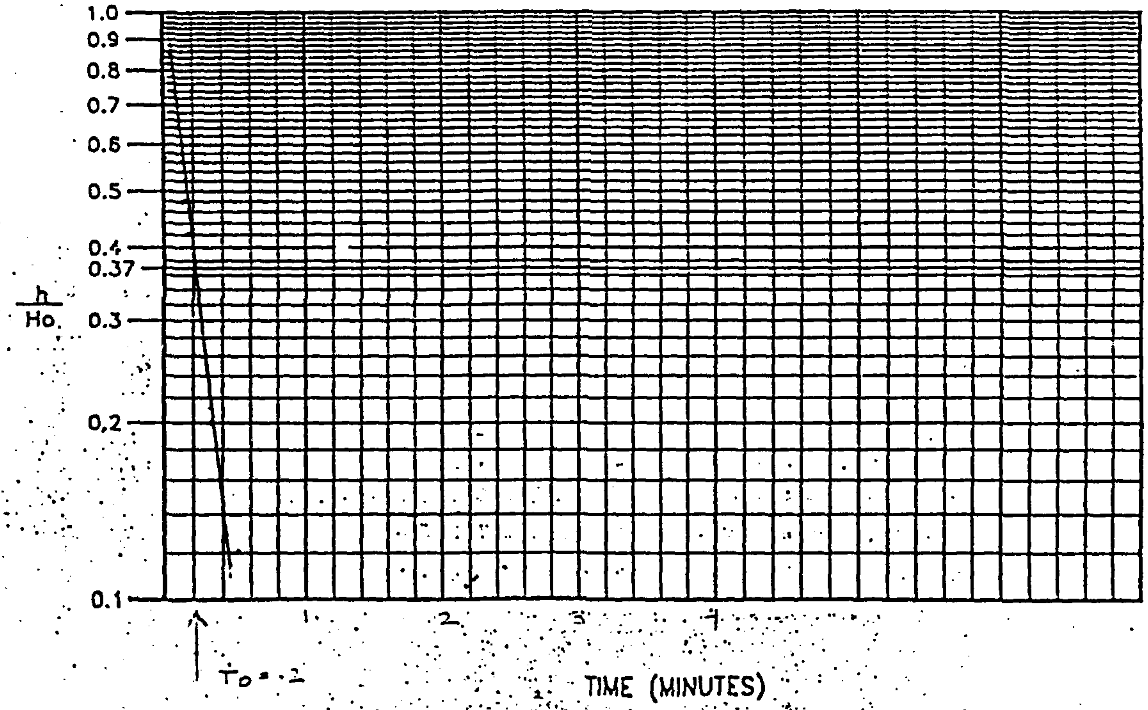
HYDRAULIC CONDUCTIVITY:

$$K=\frac{r^2\ln(L/R)}{2LTo}$$

$$K=\frac{(.083)^2\ln(5.5/.417)}{2(5.5)(.2)}$$

| TIME (MIN) | WATER DEPTH (FT) | RECOVERY TO STATIC ±(WATER DEPTH−STAT) | | $\frac{h}{Ho}$ |
|---|---|---|---|---|
| STATIC | 25.84 | — | | — |
| 00 | 27.62 | 1.78 | (Ho) | 1.00 |
| .03 | 27.35 | 1.51 | (h) | .85 |
| .07 | 27.16 | 1.32 | (h) | .74 |
| .10 | 26.99 | 1.15 | (h) | .65 |
| .13 | 26.84 | 1.0 | (h) | .56 |
| .17 | 26.70 | .86 | (h) | .48 |
| .19 | 26.58 | .74 | (h) | .42 |
| .37 | 26.19 | .35 | (h) | .20 |
| .53 | 26.03 | .19 | (h) | .12 |
| .70 | 25.96 | .12 | (h) | .07 |
| .87 | 25.92 | .08 | (h) | .04 |
| 1.03 | 25.90 | .06 | (h) | .03 |
| 2.37 | 25.86 | .02 | (h) | .01 |
| | | | (h) | |

K= .0081 FT/MIN K= 11.66 FT/DAY K= $4.1 \times 10^{-3}$ CM/SEC



HVRSLDS

# APPENDIX G

# SURVEYOR RESULTS

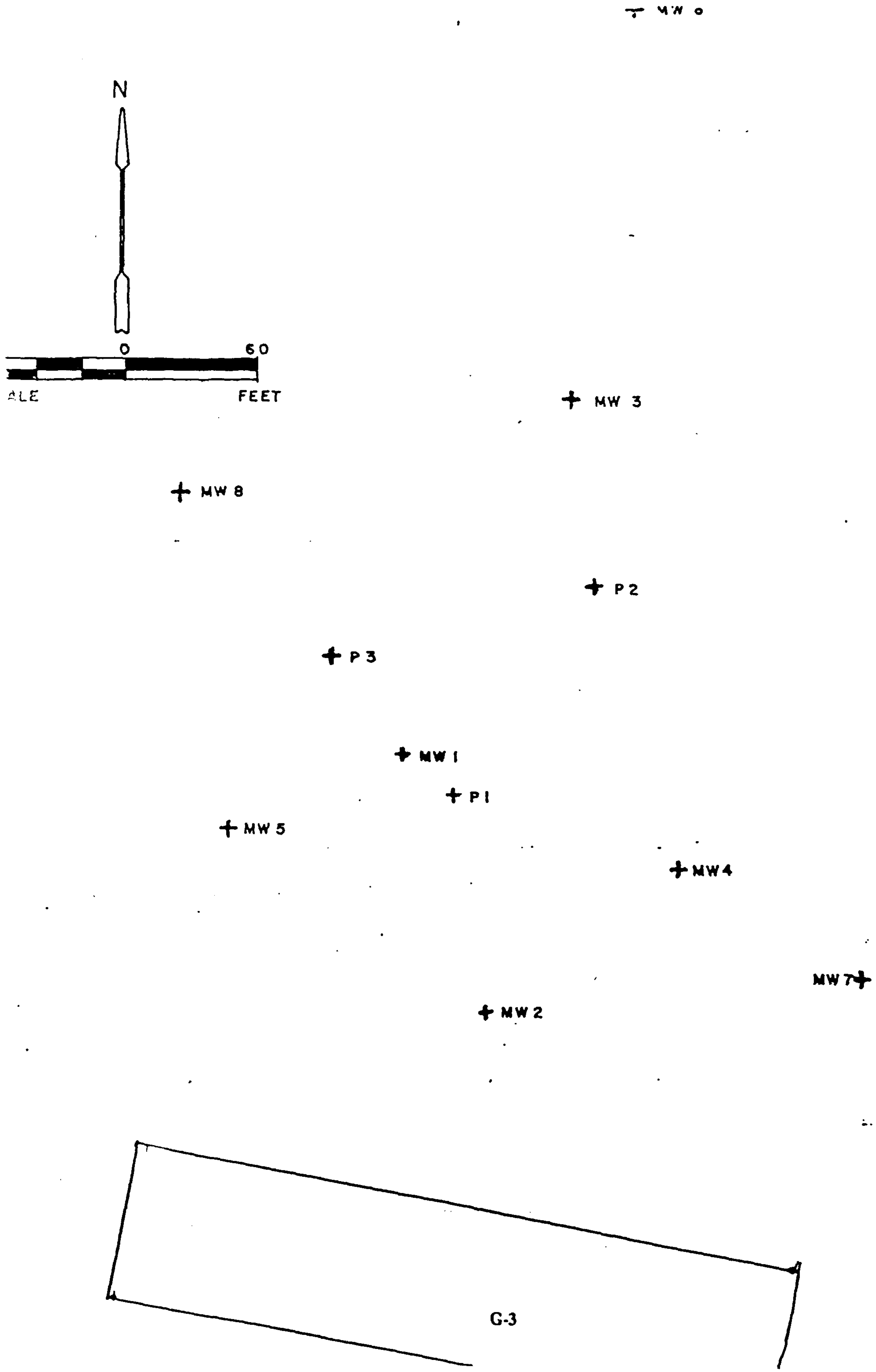
| Boring | Ground Elev. |
|---|---|
| A (5) | 1092.3 |
| B (1) | 1092.5 |
| C (4) | 1092.2 |
| D (3) | 1091.7 |
| E (2) | 1093.7 |

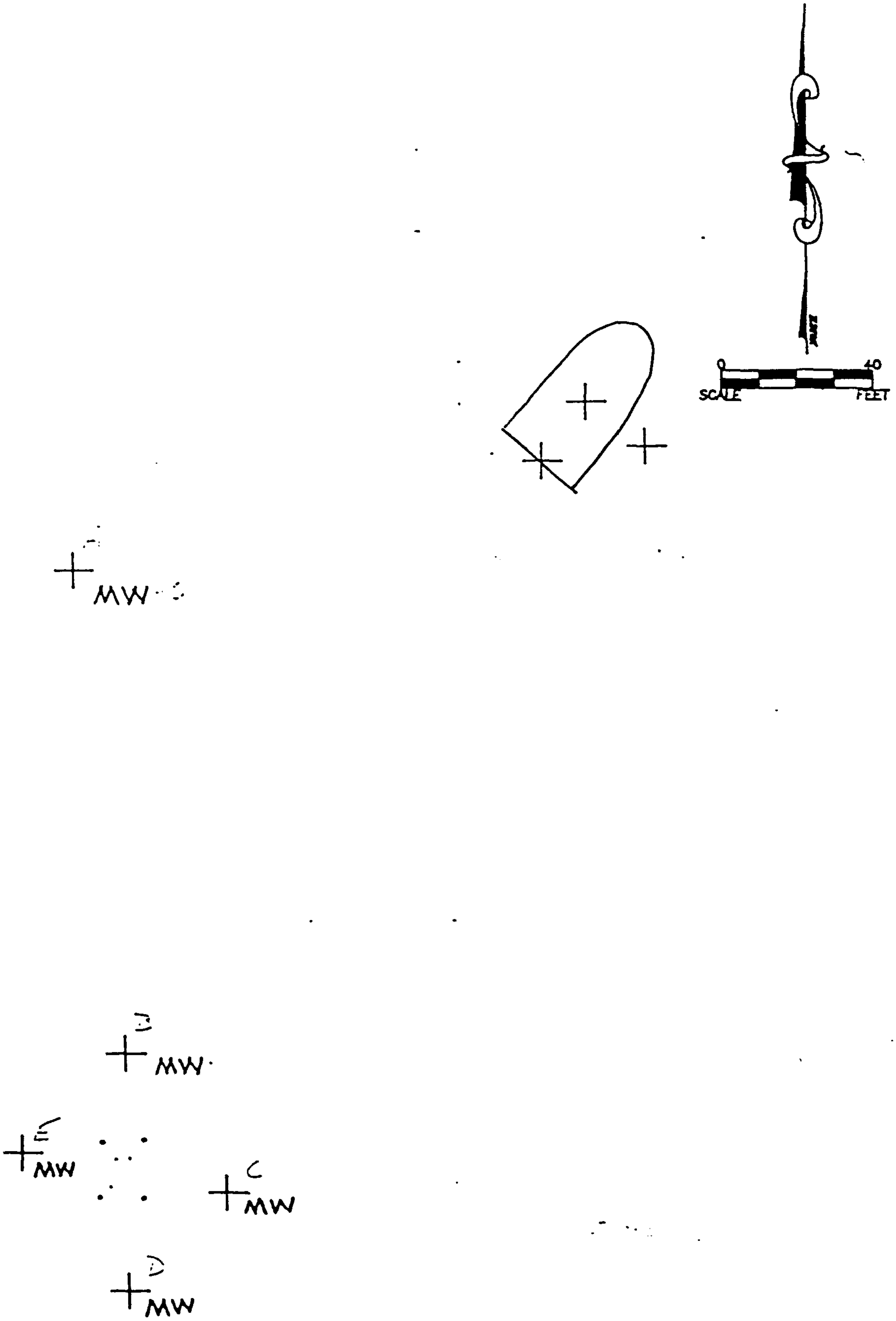
Site 2

1) Temporary well [illegible]

| Monitering Well | Rim Elev. | Top of Casing Elev. |
|---|---|---|
| MW #1 | 1092.29 | 1091.98 |
| MW #2 | 1093.38 | 1093.04 |
| MW #3 | 1091.25 | 1090.90 |
| MW #4 | 1092.91 | 1092.49 |
| MW #5 | 1092.75 | Locked |
| MW #6 | 1091.41 | 1091,07 |
| MW #7 | 1092.87 | 1092.53 |
| MW #8 | 1091.09 | 1090,79 |
| P1 | 1092.74 | 1092.51 |
| P2 | 1092.09 | 1091,83 |
| P3 | 1092.10 | 1091.32 |

Site 1


MW 6
N
0
60
ALE
FEET
MW 3
MW 8
P 2
P 3
MW 1
P 1
MW 5
MW 4
MW 7
MW 2


0
40
SCALE
FEET
MW
B
MW
E
MW
C
MW
D
MW

# APPENDIX H

# ANALYTICAL RESULTS SUMMARY TABLES

| IANG SITE 1 WATER SAMPLES | TPH | SEMI-VOLATILES | VOLATILES |
|---|---|---|---|
| Client's ID: | IANG-1<br>MW-2 | IANG-1<br>MW-5 | IANG-1<br>MW-6 |
| Date Sampled: | 15-Aug-90 | 15-Aug-90 | 15-Aug-90 |
| Lab ID: | 2169-08 | 2169-02 | 2169-03 |
| Matrix: | Water | Water | Water |
| Associated Samples: | TB-5<br>FB-2(DIUF) | TB-5<br>FB-2(DIUF) | TB-5<br>FB-2(DIUF) |
| **Volatile Organics (ug/l)** | | | |
| Date Analyzed: | 28-Aug-90 | 28-Aug-90 | 25-Aug-90 |
| Benzene | 3 | 180 | 1 U |
| Ethyl Benzene | 2 U | 4 | 2 U |
| Toluene | 2 U | 2 | 2 U |
| Xylenes | 6 | 12 | 4 U |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |
| **Semi-Volatile Organics (ug/l)** | | | |
| Date Analyzed: | 23-Aug-90 | 23-Aug-90 | 24-Aug-90 |
| N-Nitroso-Dimethylamine | 20 U | 20 UJ | 20 UJ |
| Phenol | 20 U | 20 U | 20 U |
| bis(2-Chloroethyl)ether | 20 U | 20 UJ | 20 UJ |
| 2-Chlorophenol | 20 U | 20 U | 20 U |
| 1,3-Dichlorobenzene | 20 U | 20 UJ | 20 UJ |
| 1,4-Dichlorobenzene | 20 U | 20 UJ | 20 UJ |
| Benzyl Alcohol | 20 U | 20 UJ | 20 UJ |
| 1,2-Dichlorobenzene | 20 U | 20 UJ | 20 UJ |
| 2-Methylphenol | 20 U | 20 U | 20 U |
| bis(2-chloroisopropyl)Ether | 20 U | 20 UJ | 20 UJ |
| 4-Methylphenol | 20 U | 20 U | 20 U |
| N-Nitroso-Di-n-Propylamine | 20 U | 20 UJ | 20 UJ |
| Hexachloroethane | 20 U | 20 UJ | 20 UJ |
| Nitrobenzene | 20 U | 20 UJ | 20 UJ |
| Isophorone | 20 U | 20 UJ | 20 UJ |
| 2-Nitrophenol | 20 U | 20 U | 20 U |
| 2,4-Dimethylphenol | 20 U | 20 U | 20 U |
| bis(2-Chloroethoxy)methane | 20 U | 20 UJ | 20 UJ |
| 2,4-Dichlorophenol | 20 U | 20 U | 20 U |
| Benzoic Acid | 100 U | 100 UJ | 100 UJ |
| 1,2,4-Trichlorobenzene | 20 U | 20 UJ | 20 UJ |
| Naphthalene | 20 U | 20 UJ | 20 UJ |
| 4-Chloroaniline | 20 U | 20 UJ | 20 UJ |
| Hexachlorobutadiene | 20 U | 20 UJ | 20 UJ |
| 4-Chloro-3-Methylphenol | 20 U | 20 U | 20 U |
| 2-Methylnaphthalene | 20 U | 20 UJ | 20 UJ |
| Hexachlorocyclopentadiene | 20 U | 20 UJ | 20 UJ |
| 2,4,6-Trichlorophenol | 20 U | 20 U | 20 U |
| 2,4,5-Trichlorophenol | 100 U | 100 U | 100 U |
| 2-Chloronaphthalene | 20 U | 20 UJ | 20 UJ |
| 2-Nitroaniline | 100 U | 100 UJ | 100 UJ |
| Dimethylphthalate | 20 U | 20 UJ | 20 UJ |
| Acenaphthylene | 20 U | 20 UJ | 20 UJ |
| 2,6-Dinitrotoluene | 20 U | 20 UJ | 20 UJ |
| 3-Nitroaniline | 100 U | 100 UJ | 100 UJ |
| Acenaphthene | 20 U | 20 UJ | 20 UJ |
| 2,4-Dinitrophenol | 100 U | 100 U | 100 U |
| Dibenzofuran | 20 U | 20 UJ | 20 UJ |
| 4-Nitrophenol | 100 U | 100 U | 100 U |
| 2,4-Dinitrotoluene | 20 U | 20 UJ | 20 UJ |
| Fluorene | 20 U | 20 UJ | 20 UJ |
| Diethylphthalate | 20 U | 20 UJ | 20 UJ |
| 4-Chlorophenyl-phenylether | 20 U | 20 UJ | 20 UJ |
| 4-Nitroaniline | 100 U | 100 UJ | 100 UJ |
| 4,6-Dinitro-2-Methylphenol | 100 U | 100 U | 100 U |
| N-Nitrosodiphenylamine | 20 U | 20 UJ | 20 UJ |
| 4-Bromophenyl-phenylether | 20 U | 20 UJ | 20 UJ |
| Hexachlorobenzene | 20 U | 20 UJ | 20 UJ |
| Pentachlorophenol | 100 U | 100 U | 100 U |
| Phenanthrene | 20 U | 20 UJ | 20 UJ |
| Anthracene | 20 U | 20 UJ | 20 UJ |
| Di-n-Butylphthalate | 20 U | 20 UJ | 20 UJ |
| Fluoranthene | 20 U | 20 UJ | 20 UJ |
| Pyrene | 20 U | 20 UJ | 20 UJ |
| Butylbenzylphthalate | 20 U | 20 UJ | 20 UJ |
| Benzo(a)Anthracene | 20 U | 20 UJ | 20 UJ |
| 3,3'-Dichlorobenzidine | 40 U | 40 UJ | 40 UJ |
| Chrysene | 20 U | 20 UJ | 20 UJ |
| bis(2-Ethylhexyl)Phthalate | 20 U | 20 UJ | 20 UJ |
| Di-n-octylphthalate | 20 U | 20 UJ | 20 UJ |
| Benzo(b)Fluoranthene | 20 U | 20 UJ | 20 UJ |
| Benzo(k)Fluoranthene | 20 U | 20 UJ | 20 UJ |
| Benzo(a)Pyrene | 20 U | 20 UJ | 20 UJ |
| Indeno(1,2,3-cd)Pyrene | 20 U | 20 UJ | 20 UJ |
| Dibenz(a,h)Anthracene | 20 U | 20 UJ | 20 UJ |
| Benzo(g,h,i)Perylene | 20 U | 20 UJ | 20 UJ |
| **Miscellaneous Parameters** | | | |
| Date Analyzed: | 27-Aug-90 | 27-Aug-90 | 27-Aug-90 |
| TPH (mg/l) | 1 U | 1 U | 1 U |

Footnotes:

J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.
R--Data is unusable.

| IANG SITE 1 WATER SAMPLES | SEMI-VOLATILES | VOLATILES | TPH |
|---|---|---|---|
| Client's ID: | IANG-1 MW-7 | IANG-1 MW-8 | IANG-1 DEFUELING PIT |
| Date Sampled: | 15 Aug-90 | 15-Aug-90 | 15-Aug-90 |
| Lab ID: | 2169-10 | 2169-05 | 2169-01 |
| Matrix: | Water | Water | Water |
| Associated Samples: | TB-5<br>FB-2(DIUF) | TB-5<br>FB-2(DIUF) | TB-5<br>FB-2(DIUF) |
| **Volatile Organics (ug/l)** | | | |
| Date Analyzed: | 26-Aug-90 | 25-Aug-90 | 28-Aug-90 |
| Benzene | 1 U | 1 U | 3 |
| Ethyl Benzene | 2 U | 2 U | 150 |
| Toluene | 2 U | 2 U | 5 |
| Xylenes | 4 U | 4 U | 360 |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |
| **Semi-Volatile Organics (ug/l)** | | | |
| Date Analyzed: | 23-Aug-90 | 24-Aug-90 | 23-Aug-90 |
| N-Nitroso-Dimethylamine | 20 R | 20 UJ | 20 UJ |
| Phenol | 20 R | 20 U | 20 UJ |
| bis(2-Chloroethyl)ether | 20 R | 20 UJ | 20 UJ |
| 2-Chlorophenol | 20 R | 20 U | 20 UJ |
| 1,3-Dichlorobenzene | 20 R | 20 UJ | 20 UJ |
| 1,4-Dichlorobenzene | 20 R | 20 UJ | 20 UJ |
| Benzyl Alcohol | 20 R | 20 UJ | 20 UJ |
| 1,2-Dichlorobenzene | 20 R | 20 UJ | 20 UJ |
| 2-Methylphenol | 20 R | 20 U | 20 UJ |
| bis(2-chloroisopropyl)Ether | 20 R | 20 UJ | 20 UJ |
| 4-Methylphenol | 20 R | 20 U | 20 UJ |
| N-Nitroso-Di-n-Propylamine | 20 R | 20 UJ | 20 UJ |
| Hexachloroethane | 20 R | 20 UJ | 20 UJ |
| Nitrobenzene | 20 R | 20 UJ | 20 UJ |
| Isophorone | 20 R | 20 UJ | 20 UJ |
| 2-Nitrophenol | 20 R | 20 U | 20 UJ |
| 2,4-Dimethylphenol | 20 R | 20 U | 10 UJ |
| bis(2-Chloroethoxy)methane | 20 R | 20 UJ | 20 UJ |
| 2,4-Dichlorophenol | 20 R | 20 U | 20 UJ |
| Benzoic Acid | 100 R | 100 UJ | 100 UJ |
| 1,2,4-Trichlorobenzene | 20 R | 20 UJ | 20 UJ |
| Naphthalene | 20 R | 20 UJ | 20 UJ |
| 4-Chloroaniline | 20 R | 20 UJ | 20 UJ |
| Hexachlorobutadiene | 20 R | 20 UJ | 20 UJ |
| 4-Chloro-3-Methylphenol | 20 R | 20 U | 20 UJ |
| 2-Methylnaphthalene | 20 R | 20 UJ | 20 UJ |
| Hexachlorocyclopentadiene | 20 R | 20 UJ | 20 UJ |
| 2,4,6-Trichlorophenol | 20 R | 20 U | 20 UJ |
| 2,4,5-Trichlorophenol | 100 R | 100 U | 100 UJ |
| 2-Chloronaphthalene | 20 R | 20 UJ | 20 UJ |
| 2-Nitroaniline | 100 R | 100 UJ | 100 UJ |
| Dimethylphthalate | 20 R | 20 UJ | 20 UJ |
| Acenaphthylene | 20 R | 20 UJ | 20 UJ |
| 2,6-Dinitrotoluene | 20 R | 20 UJ | 20 UJ |
| 3-Nitroaniline | 100 R | 100 UJ | 100 UJ |
| Acenaphthene | 20 R | 20 UJ | 20 UJ |
| 2,4-Dinitrophenol | 100 R | 100 U | 100 UJ |
| Dibenzofuran | 20 R | 20 UJ | 20 UJ |
| 4-Nitrophenol | 100 R | 100 U | 100 UJ |
| 2,4-Dinitrotoluene | 20 R | 20 UJ | 20 UJ |
| Fluorene | 20 R | 20 UJ | 20 UJ |
| Diethylphthalate | 20 R | 20 UJ | 20 UJ |
| 4-Chlorophenyl-phenylether | 20 R | 20 UJ | 20 UJ |
| 4-Nitroaniline | 100 R | 100 UJ | 100 UJ |
| 4,6-Dinitro-2-Methylphenol | 100 R | 100 U | 100 UJ |
| N-Nitrosodiphenylamine | 20 R | 20 UJ | 20 UJ |
| 4-Bromophenyl-phenylether | 20 R | 20 UJ | 20 UJ |
| Hexachlorobenzene | 20 R | 20 UJ | 20 UJ |
| Pentachlorophenol | 100 R | 100 U | 100 UJ |
| Phenanthrene | 20 R | 20 UJ | 20 UJ |
| Anthracene | 20 R | 20 UJ | 20 UJ |
| Di-n-Butylphthalate | 20 R | 14 UJ | 20 UJ |
| Fluoranthene | 20 R | 20 UJ | 20 UJ |
| Pyrene | 20 R | 20 UJ | 20 UJ |
| Butylbenzylphthalate | 20 R | 20 UJ | 20 UJ |
| Benzo(a)Anthracene | 20 R | 20 UJ | 20 UJ |
| 3,3'-Dichlorobenzidine | 40 R | 40 UJ | 40 UJ |
| Chrysene | 20 R | 20 UJ | 20 UJ |
| bis(2-Ethylhexyl)Phthalate | 20 R | 9 UJ | 20 UJ |
| Di-n-octylphthalate | 20 R | 20 UJ | 20 UJ |
| Benzo(b)Fluoranthene | 20 R | 20 UJ | 20 UJ |
| Benzo(k)Fluoranthene | 20 R | 20 UJ | 20 UJ |
| Benzo(a)Pyrene | 20 R | 20 UJ | 20 UJ |
| Indeno(1,2,3-cd)Pyrene | 20 R | 20 UJ | 20 UJ |
| Dibenz(a,h)Anthracene | 20 R | 20 UJ | 20 UJ |
| Benzo(g,h,i)Perylene | 20 R | 20 UJ | 20 UJ |
| **Miscellaneous Parameters** | | | |
| Date Analyzed: | 27-Aug-90 | 27-Aug-90 | 27-Aug-90 |
| TPH (mg/l) | 1 U | 1 U | 1 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.
R--Data is unusable.

IANG SITES 1 AND 2 SOIL DUPLICATE SAMPLES VOLATILES SEMI-VOLATILES TPH RADIOLOGICAL PARAMETERS

| Client's ID: | IANG-1<br>SB-7<br>MW-6-S2 | IANG-1<br>SB-7<br>MW-6-S2-D | IANG-1<br>SB-7<br>MW-6-BR2 | IANG-1<br>SB-7<br>MW-6-BR2-D | IANG-1<br>SB-9<br>MW-8-S2 | IANG-1<br>SB-9<br>MW-8-S2-D |
|---|---|---|---|---|---|---|
| Date Sampled: | 10-Aug-90 | 10-Aug-90 | 10-Aug-90 | 10-Aug-90 | 12-Aug-90 | 12-Aug-90 |
| Lab ID: | 2136-08 | 2136-09 | | | 2136-13 | 2136-14 |
| Matrix: | Soil | Soil | Soil | Soil | Soil | Soil |
| **Volatile Organics (ug/kg)** | | | | | | |
| Date Analyzed: | 21-Aug-90 | 20-Aug-90 | -- | -- | 21-Aug-90 | 21-Aug-90 |
| Benzene | 1 U | 1 U | -- | -- | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | -- | -- | 2 U | 2 U |
| Toluene | 2 U | 2 U | -- | -- | 2 U | 2 U |
| Xylenes | 2 U | 2 U | -- | -- | 2 U | 2 U |
| Chlorobenzene | 2 U | 2 U | -- | -- | 2 U | 2 U |
| 1,2 Dichlorobenzene | 2 U | 2 U | -- | -- | 2 U | 2 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | -- | -- | 4 U | 4 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | -- | -- | 3 U | 3 U |
| **Semi-Volatile Organics (ug/kg)** | | | | | | |
| Date Analyzed: | 24-Aug-90 | 24-Aug-90 | -- | -- | 24-Aug-90 | 24-Aug-90 |
| N-Nitroso-Dimethylamine | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Phenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| bis(2-Chloroethyl)ether | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2-Chlorophenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 1,3-Dichlorobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 1,4-Dichlorobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzyl Alcohol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 1,2-Dichlorobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2-Methylphenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| bis(2-chloroisopropyl)Ether | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Methylphenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| N-Nitroso-Di-n-Propylamine | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Hexachloroethane | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Nitrobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Isophorone | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2-Nitrophenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,4-Dimethylphenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| bis(2-Chloroethoxy)methane | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,4-Dichlorophenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzoic Acid | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| 1,2,4-Trichlorobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Naphthalene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Chloroaniline | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Hexachlorobutadiene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Chloro-3-Methylphenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2-Methylnaphthalene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Hexachlorocyclopentadiene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,4,6-Trichlorophenol | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,4,5-Trichlorophenol | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| 2-Chloronaphthalene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2-Nitroaniline | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Dimethylphthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Acenaphthylene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,6-Dinitrotoluene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 3-Nitroaniline | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| Acenaphthene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 2,4-Dinitrophenol | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| Dibenzofuran | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Nitrophenol | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| 2,4-Dinitrotoluene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Fluorene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Diethylphthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Chlorophenyl-phenylether | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Nitroaniline | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| 4,6-Dinitro-2-Methylphenol | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| N-Nitrosodiphenylamine | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 4-Bromophenyl-phenylether | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Hexachlorobenzene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Pentachlorophenol | 1700 U | 1700 U | -- | -- | 1800 U | 1700 U |
| Phenanthrene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Anthracene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Di-n-Butylphthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Fluoranthene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Pyrene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Butylbenzylphthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzo(a)Anthracene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| 3,3'-Dichlorobenzidine | 720 U | 720 U | -- | -- | 720 U | 700 U |
| Chrysene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| bis(2-Ethylhexyl)Phthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Di-n-octylphthalate | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzo(b)Fluoranthene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzo(k)Fluoranthene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzo(a)Pyrene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Indeno(1,2,3-cd)Pyrene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Dibenz(a,h)Anthracene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| Benzo(g,h,i)Perylene | 360 U | 360 U | -- | -- | 360 U | 350 U |
| **Miscellaneous Parameters** | | | | | | |
| Date Analyzed: | 27-Aug-90 | 27-Aug-90 | -- | -- | 27-Aug-90 | 31-Aug-90 |
| TPH (mg/kg) | 11 U | 11 U | -- | -- | 11 U | 11 U |
| **Radiological Parameters (pCi/g)** | | | | | | |
| Date Analyzed: | | | | | | |
| Gross Alpha | -- | -- | 0.5 U | 0.5 U | -- | -- |
| Gross Beta | -- | -- | 0.8 U | 0.8 U | -- | -- |
| Radium-226 | -- | -- | 0.51+/-0.34 U | 0.58+/-0.20 U | -- | -- |
| Radium-228 | -- | -- | 0.5 U | 0.72+/-0.14 U | -- | -- |

Footnotes:

J--the value reported is an estimated concentration. This is used when the compound detected at an amount less than the reporting limit.

U--the compound was analyzed for, but not detected.

## RADIOLOGICAL PARAMETERS

IANG WATER SAMPLES

| Client's ID: | IANG-2<br>MW-1 | IANG-2<br>MW-2 | IANG-2<br>MW-3 | IANG-2<br>MW-4 | IANG-2<br>MW-5 | IANG-2<br>MW-6<br>DUP OF MW-5 | IANG-1<br>MW-6 | IANG-1<br>MW-10<br>DUP OF MW-6 | UST SITE<br>MW-1<br>BACKGROUND |
|---|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | 14-Aug-90 | 15-Aug-90 | | | 12-Dec-90 |
| Matrix: | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| Associated Samples: | FB-2(TAP)<br>FB-2(DIUF) | | | | | | RB-5 | | |
| DATE ANALYZED | | | | | | | | | |
| Radiological Parameters, pCi/l | | | | | | | | | |
| Gross Alpha | 22+/-10 | 14+/-9 | 4+/-3 | 19+/-9 | 9+/-8 | 11+/-8 | 21+/-7 | 20+/-7 | 25+/-4 |
| Gross Beta | 33+/-12 | 35+/-12 | 19+/-6 | 45+/-12 | 36+/-12 | 22+/-11 | 32+/-7 | 43+/-7 | 41+/-5 |
| Radium-226 | 0.6 U | 1.7+/-0.6 | 4.1+/-1 | 0.8+/-0.5 | 0.6 U | 1.0+/-0.5 | 17.0+/-7.8 | 7.9+/-4.2 | ---- |
| Radium-228 | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | ---- |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE SOIL SAMPLES RADIOLOGICAL PARAMETERS

| Client's ID: | IANG-2 SB-1-S1 | IANG-2 SB-1-S2 | IANG-2 SB-1-S3 | IANG-2 SB-2-S1 | IANG-2 SB-2-S2 | IANG-2 SB-2-S3 | IANG-2 SB-3-S1 | IANG-2 SB-4-S1 |
|---|---|---|---|---|---|---|---|---|
| Date Sampled: | 27-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 28-Jul-90 | 29-Jul-90 | 30-Jul-90 |
| Matrix: | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Associated Samples: | RB-1 | RB-2 | RB-2 | RB-2 | RB-2 | RB-2 | RB-3 | RB-4 |
| DATE ANALYZED | | | | | | | | |
| Radiological Parameters (pCi/g) | | | | | | | | |
| Gross Alpha | 0.9+/-0.6 | 2.5+/-0.7 | 1.5+/-0.7 | 1.8+/-0.8 | 2.3+/-0.7 | 1.2+/-0.6 | 2.0+/-0.8 | 1.7+/-0.7 |
| Gross Beta | 3.3+/-0.9 | 3.5+/-0.8 | 1.4+/-0.9 | 2.6+/-0.8 | 4.5+/-0.9 | 2.5+/-0.8 | 3.5+/-0.8 | 3.8+/-1.0 |
| Radium-226 | 0.74+/-0.23 | 0.72+/-0.26 | 1.5+/-0.2 | 0.82+/-0.20 | 0.71+/-0.22 | 1.3+/-0.2 | 1.6+/-0.2 | 1.4+/-0.3 |
| Radium-228 | 0.2 U | 1.2+/-0.2 | 0.2 U | 1.1+/-0.2 | 0.85+/-0.30 | 0.2 U | 0.2 | 1.6+/-0.3 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE SOIL SAMPLES

| Client's ID: | IANG-2 SB-4-S2 | IANG-2 SB-4-S3 | IANG-2 SB-5-S1 | IANG-2 SB-5-S2 | IANG-2 SB-5-S3 | IANG-2 SB-5-S4 | IANG-2 BENTONITE |
|---|---|---|---|---|---|---|---|
| Date Sampled: | 30-Jul-90 | 30-Jul-90 | 30-Jul-90 | 30-Jul-90 | 30-Jul-90 | 30-Jul-90 | 30-Jul-90 |
| Matrix: | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Associated Samples: | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) | RB-4<br>FB-1(TAP) |
| DATE ANALYZED | | | | | | | |
| Radiological Parameters (pCi/g) | | | | | | | |
| Gross Alpha | 3.3+/-0.8 | 1.5+/-0.6 | 0.7+/-0.5 | 1.1+/-0.6 | 1.0+/-0.6 | 0.9+/-0.6 | 11.4+/-1.4 |
| Gross Beta | 5.3+/-1.0 | 1.3+/-0.8 | 1.8+/-0.8 | 1.9+/-1.0 | 2.3+/-1.0 | 0.8 U | 8.8+/-1.3 |
| Radium-226 | 0.93+/-0.16 | 0.78+/-0.15 | 1.6+/-0.2 | 0.55+/-0.28 | 0.85+/-0.25 | 0.36+/-0.10 | 4.9+/-0.3 |
| Radium-228 | 1.9+/-0.8 | 1.8+/-0.9 | 2.4+/-1.1 | 0.2 U | 0.2 U | 2.4+/-0.5 | 8.9+/-1.4 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE SOIL SAMPLES

| Client's ID: | IANG-1 SB-7/ MW-6-BR1 | IANG-1 SB-7/ MW-6-BR2 | UST SITE MW-1 (15'-17') | UST SITE MW-1 (25'-27') |
|---|---|---|---|---|
| Date Sampled: | 10-Aug-90 | 10-Aug-90 | 12-DEC-90 | 12-DEC-90 |
| Matrix: | Soil<br>BACKGROUND | Soil<br>BACKGROUND | Soil<br>BACKGROUND | Soil<br>BACKGROUND |
| Associated Samples: | RB-2<br>FB-1(TAP) | RB-2<br>FB-1(TAP) | | |
| DATE ANALYZED | | | | |
| Radiological Parameters (pCi/g) | | | | |
| Gross Alpha | 35.6+/-2.4 | 0.5 | 1.2+/-0.6 | 1.6+/-0.7 |
| Gross Beta | 7.8+/-1.3 | 0.8 | 1.3+/-1.0 | 1.0+/-0.5 |
| Radium-226 | 0.3 U | 0.51+/-0.34 | --------- | --------- |
| Radium-228 | 0.5 U | 0.5 | --------- | --------- |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| | | | |
|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-9/<br>MW-8-S1 | IANG-1<br>SB-9/<br>MW-8-S2 | IANG-1<br>DEFUELING<br>PIT |
| Date Sampled: | 11-AUG-90 | 12-AUG-90 | 15-AUG-90 |
| Lab ID: | 2136-12 | 2136-13 | 2169-07 |
| Matrix: | Soil | Soil | Soil |
| Associated Samples: | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) |

Volatile Organics (ug/kg)

| | | | |
|---|---|---|---|
| Date Analyzed: | 21-AUG-90 | 21-AUG-90 | 23-AUG-90 |
| Benzene | 1 U | 1 U | 2 U |
| Ethyl Benzene | 2 U | 2 U | 3 U |
| Toluene | 2 U | 2 U | 3 U |
| Xylenes | 4 U | 4 U | 21 |
| Chlorobenzene | 2 U | 2 U | 3 U |
| 1,2 Dichlorobenzene | 4 U | 4 U | 6 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | 6 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 5 U |

Semi-Volatile Organics (ug/kg)

| | | | |
|---|---|---|---|
| Date Analyzed: | 24-AUG-90 | 24-AUG-90 | 30-AUG-90 |
| N-Nitroso-Dimethylamine | 340 U | 360 U | 520 U |
| Phenol | 340 U | 360 U | 520 U |
| bis(2-Chloroethyl)ether | 340 U | 360 U | 520 U |
| 2-Chlorophenol | 340 U | 360 U | 520 U |
| 1,3-Dichlorobenzene | 340 U | 360 U | 520 U |
| 1,4-Dichlorobenzene | 340 U | 360 U | 520 U |
| Benzyl Alcohol | 340 U | 360 U | 520 U |
| 1,2-Dichlorobenzene | 340 U | 360 U | 520 U |
| 2-Methylphenol | 340 U | 360 U | 520 U |
| bis(2-chloroisopropyl)Eth | 340 U | 360 U | 520 U |
| 4-Methylphenol | 340 U | 360 U | 520 U |
| N-Nitroso-Di-n-Propylamin | 340 U | 360 U | 520 U |
| Hexachloroethane | 340 U | 360 U | 520 U |
| Nitrobenzene | 340 U | 360 U | 520 U |
| Isophorone | 340 U | 360 U | 520 U |
| 2-Nitrophenol | 340 U | 360 U | 520 U |
| 2,4-Dimethylphenol | 340 U | 360 U | 520 U |
| bis(2-Chloroethoxy)methan | 340 U | 360 U | 520 U |
| 2,4-Dichlorophenol | 340 U | 360 U | 520 U |
| Benzoic Acid | 1600 U | 1800 U | 2500 U |
| 1,2,4-Trichlorobenzene | 340 U | 360 U | 520 U |
| Naphthalene | 340 U | 360 U | 520 U |
| 4-Chloroaniline | 340 U | 360 U | 520 U |
| Hexachlorobutadiene | 340 U | 360 U | 520 U |
| 4-Chloro-3-Methylphenol | 340 U | 360 U | 520 U |
| 2-Methylnaphthalene | 340 U | 360 U | 520 U |
| Hexachlorocyclopentadiene | 340 U | 360 U | 520 U |
| 2,4,6-Trichlorophenol | 340 U | 360 U | 520 U |
| 2,4,5-Trichlorophenol | 1600 U | 1800 U | 2500 U |
| 2-Chloronaphthalene | 340 U | 360 U | 520 U |
| 2-Nitroaniline | 340 U | 360 U | 520 U |
| Dimethylphthalate | 340 U | 360 U | 520 U |
| Acenaphthylene | 340 U | 360 U | 520 U |
| 2,6-Dinitrotoluene | 340 U | 360 U | 520 U |
| 3-Nitroaniline | 1600 U | 1800 U | 2500 U |
| Acenaphthene | 340 U | 360 U | 520 U |
| 2,4-Dinitrophenol | 1600 U | 1800 U | 2500 U |
| Dibenzofuran | 340 U | 360 U | 520 U |
| 4-Nitrophenol | 1600 U | 1800 U | 2500 U |
| 2,4-Dinitrotoluene | 340 U | 360 U | 520 U |
| Fluorene | 340 U | 360 U | 520 U |
| Diethylphthalate | 340 U | 360 J | 520 U |
| 4-Chlorophenyl-phenylethe | 340 U | 360 U | 520 U |
| 4-Nitroaniline | 1600 U | 1800 U | 2500 U |
| 4,6-Dinitro-2-Methylpheno | 1600 U | 1800 U | 2500 U |
| N-Nitrosodiphenylamine | 340 U | 360 U | 520 U |
| 4-Bromophenyl-phenylether | 340 U | 360 U | 520 U |
| Hexachlorobenzene | 340 U | 360 U | 520 U |
| Pentachlorophenol | 1600 U | 1800 U | 2500 U |
| Phenanthrene | 340 U | 360 U | 520 U |
| Anthracene | 340 U | 360 U | 520 U |
| Di-n-Butylphthalate | 340 U | 360 U | 520 U |
| Fluoranthene | 340 U | 360 U | 240 J |
| Pyrene | 340 U | 360 U | 580 |
| Butylbenzylphthalate | 340 U | 360 U | 520 U |
| Benzo(a)Anthracene | 340 U | 360 U | 290 J |
| 3,3'-Dichlorobenzidine | 670 U | 730 U | 1000 U |
| Chrysene | 340 U | 360 U | 340 J |
| bis(2-Ethylhexyl)Phthalat | 340 U | 360 U | 520 U |
| Di-n-octylphthalate | 340 U | 360 U | 520 U |
| Benzo(b)Fluoranthene | 340 U | 360 U | 710 |
| Benzo(k)Fluoranthene | 340 U | 360 U | 520 U |
| Benzo(a)Pyrene | 340 U | 360 U | 520 U |
| Indeno(1,2,3-cd)Pyrene | 340 U | 360 U | 520 U |
| Dibenz(a,h)Anthracene | 340 U | 360 U | 520 U |
| Benzo(g,h,i)Perylene | 340 U | 360 U | 520 U |

IANG SITE 1 SOIL SAMPLES

| | | | |
|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-9/<br>MW-8-S1 | IANG-1<br>SB-9/<br>MW-8-S2 | IANG-1<br>DEFUELING<br>PIT |
| Date Sampled: | 11-AUG-90 | 12-AUG-90 | 15-AUG-90 |
| Lab ID: | 2136-12 | 2136-13 | 2169-07 |
| Matrix: | Soil | Soil | Soil |

Miscellaneous Parameters

| | | | |
|---|---|---|---|
| Date Analyzed: | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 10 U | 11 U | 160 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| | | | | |
|---|---|---|---|---|
| SAMPLE ID: | IANG-1 SB-7/ MW-6-S1 | IANG-1 SB-7/ MW-6-S2 | IANG-1 SB-8/ MW-7-S1 | IANG-1 SB-8/ MW-7-S2 |
| Date Sampled: | 10-AUG-90 | 10-AUG-90 | 11-AUG-90 | 11-AUG-90 |
| Lab ID: | 2136-07 | 2136-08 | 2136-10 | 2136-11 |
| Matrix: | Soil | Soil | Soil | Soil |
| Associated Samples: | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) |
| **Volatile Organics (ug/kg)** | | | | |
| Date Analyzed: | 21-AUG-90 | 21-AUG-90 | 21-AUG-90 | 21-AUG-90 |
| Benzene | 1 U | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 3 U | 3 U |
| Toluene | 5 U | 2 U | 3 U | 3 U |
| Xylenes | 5 U | 2 U | 3 U | 6 U |
| Chlorobenzene | 5 U | 2 U | 3 U | 3 U |
| 1,2 Dichlorobenzene | 5 U | 4 U | 5 U | 6 U |
| 1,3 Dichlorobenzene | 5 U | 4 U | 5 U | 6 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 4 U | 4 U |
| **Semi-Volatile Organics (ug/kg)** | | | | |
| Date Analyzed: | 24-AUG-90 | 24-AUG-90 | 24-AUG-90 | 24-AUG-90 |
| N-Nitroso-Dimethylamine | 380 U | 360 U | 440 U | 460 U |
| Phenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-Chloroethyl)ether | 380 U | 360 U | 440 U | 460 U |
| 2-Chlorophenol | 380 U | 360 U | 440 U | 460 U |
| 1,3-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| 1,4-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Benzyl Alcohol | 380 U | 360 U | 440 U | 460 U |
| 1,2-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| 2-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-chloroisopropyl)Eth | 380 U | 360 U | 440 U | 460 U |
| 4-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| N-Nitroso-Di-n-Propylamin | 380 U | 360 U | 440 U | 460 U |
| Hexachloroethane | 380 U | 360 U | 440 U | 460 U |
| Nitrobenzene | 380 U | 360 U | 440 U | 460 U |
| Isophorone | 380 U | 360 U | 440 U | 460 U |
| 2-Nitrophenol | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dimethylphenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-Chloroethoxy)methan | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dichlorophenol | 380 U | 360 U | 440 U | 460 U |
| Benzoic Acid | 1800 U | 1700 U | 2100 U | 2300 U |
| 1,2,4-Trichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Naphthalene | 380 U | 360 U | 440 U | 460 U |
| 4-Chloroaniline | 380 U | 360 U | 440 U | 460 U |
| Hexachlorobutadiene | 380 U | 360 U | 440 U | 460 U |
| 4-Chloro-3-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| 2-Methylnaphthalene | 380 U | 360 U | 440 U | 460 U |
| Hexachlorocyclopentadiene | 380 U | 360 U | 440 U | 460 U |
| 2,4,6-Trichlorophenol | 380 U | 360 U | 440 U | 460 U |
| 2,4,5-Trichlorophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| 2-Chloronaphthalene | 380 U | 360 U | 440 U | 460 U |
| 2-Nitroaniline | 1800 U | 360 U | 440 U | 460 U |
| Dimethylphthalate | 380 U | 360 U | 440 U | 460 U |
| Acenaphthylene | 380 U | 360 U | 440 U | 460 U |
| 2,6-Dinitrotoluene | 380 U | 360 U | 440 U | 460 U |
| 3-Nitroaniline | 1800 U | 1700 U | 2100 U | 2300 U |
| Acenaphthene | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dinitrophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| Dibenzofuran | 380 U | 360 U | 440 U | 460 U |
| 4-Nitrophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| 2,4-Dinitrotoluene | 380 U | 360 U | 440 U | 460 U |
| Fluorene | 380 U | 360 U | 440 U | 460 U |
| Diethylphthalate | 120 J | 360 U | 440 U | 460 U |
| 4-Chlorophenyl-phenylethe | 380 U | 360 U | 440 U | 460 U |
| 4-Nitroaniline | 1800 U | 1700 U | 2100 U | 2300 U |
| 4,6-Dinitro-2-Methylpheno | 1800 U | 1700 U | 2100 U | 2300 U |
| N-Nitrosodiphenylamine | 380 U | 360 U | 440 U | 460 U |
| 4-Bromophenyl-phenylether | 380 U | 360 U | 440 U | 460 U |
| Hexachlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Pentachlorophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| Phenanthrene | 380 U | 360 U | 440 U | 460 U |
| Anthracene | 380 U | 360 U | 440 U | 460 U |
| Di-n-Butylphthalate | 380 U | 360 U | 440 U | 460 U |
| Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Pyrene | 380 U | 360 U | 440 U | 460 U |
| Butylbenzylphthalate | 380 U | 360 U | 440 U | 460 U |
| Benzo(a)Anthracene | 380 U | 360 U | 440 U | 460 U |
| 3,3'-Dichlorobenzidine | 760 U | 720 U | 880 U | 930 U |
| Chrysene | 380 U | 360 U | 440 U | 460 U |
| bis(2-Ethylhexyl)Phthalat | 380 U | 360 U | 440 U | 460 U |
| Di-n-octylphthalate | 380 U | 360 U | 440 U | 460 U |
| Benzo(b)Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Benzo(k)Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Benzo(a)Pyrene | 380 U | 360 U | 440 U | 460 U |
| Indeno(1,2,3-cd)Pyrene | 380 U | 360 U | 440 U | 460 U |
| Dibenz(a,h)Anthracene | 380 U | 360 U | 440 U | 460 U |
| Benzo(g,h,i)Perylene | 380 U | 360 U | 440 U | 460 U |

IANG SITE 1 SOIL SAMPLES

| | | | | |
|---|---|---|---|---|
| SAMPLE ID: | IANG-1 SB-7/ MW-6-S1 | IANG-1 SB-7/ MW-6-S2 | IANG-1 SB-8/ MW-7-S1 | IANG-1 SB-8/ MW-7-S2 |
| Date Sampled: | 10-AUG-90 | 10-AUG-90 | 11-AUG-90 | 11-AUG-90 |
| Lab ID: | 2136-07 | 2136-08 | 2136-10 | 2136-11 |
| Matrix: | Soil | Soil | Soil | Soil |
| **Miscellaneous Parameter:** | | | | |
| Date Analyzed: | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 11 U | 11 U | 13 U | 17 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| SAMPLE ID: | IANG-1 SB-7/ MW-6-S1 | IANG-1 SB-7/ MW-6-S2 | IANG-1 SB-8/ MW-7-S1 | IANG-1 SB-8/ MW-7-S2 |
|---|---|---|---|---|
| Date Sampled: | 10-AUG-90 | 10-AUG-90 | 11-AUG-90 | 11-AUG-90 |
| Lab ID: | 2136-07 | 2136-08 | 2136-10 | 2136-11 |
| Matrix: | Soil | Soil | Soil | Soil |
| Associated Samples: | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) |
| **Volatile Organics (ug/kg)** | | | | |
| Date Analyzed: | 21-AUG-90 | 21-AUG-90 | 21-AUG-90 | 21-AUG-90 |
| Benzene | 1 U | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 3 U | 3 U |
| Toluene | 2 U | 2 U | 3 U | 3 U |
| Xylenes | 5 U | 4 U | 5 U | 6 U |
| Chlorobenzene | 2 U | 2 U | 3 U | 3 U |
| 1,2 Dichlorobenzene | 5 U | 4 U | 5 U | 6 U |
| 1,3 Dichlorobenzene | 5 U | 4 U | 5 U | 6 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 4 U | 4 U |
| **Semi-Volatile Organics (ug/kg)** | | | | |
| Date Analyzed: | 24-AUG-90 | 24-AUG-90 | 24-AUG-90 | 24-AUG-90 |
| N-Nitroso-Dimethylamine | 380 U | 360 U | 440 U | 460 U |
| Phenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-Chloroethyl)ether | 380 U | 360 U | 440 U | 460 U |
| 2-Chlorophenol | 380 U | 360 U | 440 U | 460 U |
| 1,3-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| 1,4-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Benzyl Alcohol | 380 U | 360 U | 440 U | 460 U |
| 1,2-Dichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| 2-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-chloroisopropyl)Eth | 380 U | 360 U | 440 U | 460 U |
| 4-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| N-Nitroso-Di-n-Propylamin | 380 U | 360 U | 440 U | 460 U |
| Hexachloroethane | 380 U | 360 U | 440 U | 460 U |
| Nitrobenzene | 380 U | 360 U | 440 U | 460 U |
| Isophorone | 380 U | 360 U | 440 U | 460 U |
| 2-Nitrophenol | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dimethylphenol | 380 U | 360 U | 440 U | 460 U |
| bis(2-Chloroethoxy)methan | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dichlorophenol | 380 U | 360 U | 440 U | 460 U |
| Benzoic Acid | 1800 U | 1700 U | 2100 U | 2300 U |
| 1,2,4-Trichlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Naphthalene | 380 U | 360 U | 440 U | 460 U |
| 4-Chloroaniline | 380 U | 360 U | 440 U | 460 U |
| Hexachlorobutadiene | 380 U | 360 U | 440 U | 460 U |
| 4-Chloro-3-Methylphenol | 380 U | 360 U | 440 U | 460 U |
| 2-Methylnaphthalene | 380 U | 360 U | 440 U | 460 U |
| Hexachlorocyclopentadiene | 380 U | 360 U | 440 U | 460 U |
| 2,4,6-Trichlorophenol | 380 U | 360 U | 440 U | 460 U |
| 2,4,5-Trichlorophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| 2-Chloronaphthalene | 380 U | 360 U | 440 U | 460 U |
| 2-Nitroaniline | 1800 U | 360 U | 440 U | 460 U |
| Dimethylphthalate | 380 U | 360 U | 440 U | 460 U |
| Acenaphthylene | 380 U | 360 U | 440 U | 460 U |
| 2,6-Dinitrotoluene | 380 U | 360 U | 440 U | 460 U |
| 3-Nitroaniline | 1800 U | 1700 U | 2100 U | 2300 U |
| Acenaphthene | 380 U | 360 U | 440 U | 460 U |
| 2,4-Dinitrophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| Dibenzofuran | 380 U | 360 U | 440 U | 460 U |
| 4-Nitrophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| 2,4-Dinitrotoluene | 380 U | 360 U | 440 U | 460 U |
| Fluorene | 380 U | 360 U | 440 U | 460 U |
| Diethylphthalate | 120 J | 360 U | 440 U | 460 U |
| 4-Chlorophenyl-phenylethe | 380 U | 360 U | 440 U | 460 U |
| 4-Nitroaniline | 1800 U | 1700 U | 2100 U | 2300 U |
| 4,6-Dinitro-2-Methylpheno | 1800 U | 1700 U | 2100 U | 2300 U |
| N-Nitrosodiphenylamine | 380 U | 360 U | 440 U | 460 U |
| 4-Bromophenyl-phenylether | 380 U | 360 U | 440 U | 460 U |
| Hexachlorobenzene | 380 U | 360 U | 440 U | 460 U |
| Pentachlorophenol | 1800 U | 1700 U | 2100 U | 2300 U |
| Phenanthrene | 380 U | 360 U | 440 U | 460 U |
| Anthracene | 380 U | 360 U | 440 U | 460 U |
| Di-n-Butylphthalate | 380 U | 360 U | 440 U | 460 U |
| Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Pyrene | 380 U | 360 U | 440 U | 460 U |
| Butylbenzylphthalate | 380 U | 360 U | 440 U | 460 U |
| Benzo(a)Anthracene | 380 U | 360 U | 440 U | 460 U |
| 3,3'-Dichlorobenzidine | 760 U | 720 U | 880 U | 930 U |
| Chrysene | 380 U | 360 U | 440 U | 460 U |
| bis(2-Ethylhexyl)Phthalat | 380 U | 360 U | 440 U | 460 U |
| Di-n-octylphthalate | 380 U | 360 U | 440 U | 460 U |
| Benzo(b)Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Benzo(k)Fluoranthene | 380 U | 360 U | 440 U | 460 U |
| Benzo(a)Pyrene | 380 U | 360 U | 440 U | 460 U |
| Indeno(1,2,3-cd)Pyrene | 380 U | 360 U | 440 U | 460 U |
| Dibenz(a,h)Anthracene | 380 U | 360 U | 440 U | 460 U |
| Benzo(g,h,i)Perylene | 380 U | 360 U | 440 U | 460 U |

IANG SITE 1 SOIL SAMPLES

| SAMPLE ID: | IANG-1 SB-7/ MW-6-S1 | IANG-1 SB-7/ MW-6-S2 | IANG-1 SB-8/ MW-7-S1 | IANG-1 SB-8/ MW-7-S2 |
|---|---|---|---|---|
| Date Sampled: | 10-AUG-90 | 10-AUG-90 | 11-AUG-90 | 11-AUG-90 |
| Lab ID: | 2136-07 | 2136-08 | 2136-10 | 2136-11 |
| Matrix: | Soil | Soil | Soil | Soil |
| **Miscellaneous Parameters** | | | | |
| Date Analyzed: | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 11 U | 11 U | 13 U | 17 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| | | | | | |
|---|---|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-4/<br>MW-3-S2 | IANG-1<br>SB-5/<br>MW-4-S1 | IANG-1<br>SB-5/<br>MW-4-S2 | IANG-1<br>SB-6/<br>MW-5-S1 | IANG-1<br>SB-6/<br>MW-5-S2 |
| Date Sampled: | 7-AUG-90 | 8-AUG-90 | 8-AUG-90 | 9-AUG-90 | 9-AUG-90 |
| Lab ID: | 2125-09 | 2125-01 | 2125-02 | 2136-05 | 2136-06 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |
| Associated Samples: | TB-1<br>RB-1 | TB-3<br>RB-4 | TB-3<br>RB-4 | TB-4<br>RB-5<br>FB-1(DIUF) | TB-4<br>RB-5<br>FB-1(DIUF) |

Volatile Organics (ug/kg)

| | | | | | |
|---|---|---|---|---|---|
| Date Analyzed: | 17-AUG-90 | 17-AUG-90 | 20-AUG-90 | 21-AUG-90 | 21-AUG-90 |
| Benzene | 380 U | 410 U | 5600 | 1 U | 1 U |
| Ethyl Benzene | 17000 | 5000 | 20000 | 3 U | 3 U |
| Toluene | 12000 | 2100 | 29000 | 3 U | 3 U |
| Xylenes | 58000 | 15000 | 53000 | 5 U | 5 U |
| Chlorobenzene | 760 U | 820 U | 2200 U | 3 U | 3 U |
| 1,2 Dichlorobenzene | 1500 U | 1600 U | 4500 U | 5 U | 5 U |
| 1,3 Dichlorobenzene | 1500 U | 1600 U | 4500 U | 5 U | 5 U |
| 1,4 Dichlorobenzene | 1100 U | 1200 U | 3400 U | 4 U | 4 U |

Semi-Volatile Organics (ug/kg)

| | | | | | |
|---|---|---|---|---|---|
| Date Analyzed: | 13-AUG-90 | 21-AUG-90 | 13-AUG-90 | 24-AUG-90 | 24-AUG-90 |
| N-Nitroso-Dimethylamine | 340 U | 340 U | 410 U | 410 U | 410 U |
| Phenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| bis(2-Chloroethyl)ether | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2-Chlorophenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| 1,3-Dichlorobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 1,4-Dichlorobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzyl Alcohol | 340 U | 340 U | 410 U | 410 U | 410 U |
| 1,2-Dichlorobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2-Methylphenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| bis(2-chloroisopropyl)Eth | 340 U | 340 U | 410 U | 410 U | 410 U |
| 4-Methylphenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| N-Nitroso-Di-n-Propylamin | 340 U | 340 U | 410 U | 410 U | 410 U |
| Hexachloroethane | 340 U | 340 U | 410 U | 410 U | 410 U |
| Nitrobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Isophorone | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2-Nitrophenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,4-Dimethylphenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| bis(2-Chloroethoxy)methan | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,4-Dichlorophenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzoic Acid | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| 1,2,4-Trichlorobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Naphthalene | 2300 | 190 U | 2700 | 410 U | 410 U |
| 4-Chloroaniline | 340 U | 340 U | 410 U | 410 U | 410 U |
| Hexachlorobutadiene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 4-Chloro-3-Methylphenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2-Methylnaphthalene | 2500 | 560 | 2900 | 410 U | 410 U |
| Hexachlorocyclopentadiene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,4,6-Trichlorophenol | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,4,5-Trichlorophenol | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| 2-Chloronaphthalene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2-Nitroaniline | 340 U | 340 U | 410 U | 410 U | 410 U |
| Dimethylphthalate | 340 U | 340 U | 410 U | 410 U | 410 U |
| Acenaphthylene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,6-Dinitrotoluene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 3-Nitroaniline | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| Acenaphthene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 2,4-Dinitrophenol | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| Dibenzofuran | 340 U | 340 U | 140 J | 410 U | 410 U |
| 4-Nitrophenol | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| 2,4-Dinitrotoluene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Fluorene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Diethylphthalate | 340 U | 340 U | 410 U | 410 U | 410 U |
| 4-Chlorophenyl-phenylethe | 340 U | 340 U | 410 U | 410 U | 410 U |
| 4-Nitroaniline | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| 4,6-Dinitro-2-Methylpheno | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| N-Nitrosodiphenylamine | 340 U | 340 U | 410 U | 410 U | 410 U |
| 4-Bromophenyl-phenylether | 340 U | 340 U | 410 U | 410 U | 410 U |
| Hexachlorobenzene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Pentachlorophenol | 1600 U | 1600 U | 2000 U | 2000 U | 2000 U |
| Phenanthrene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Anthracene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Di-n-Butylphthalate | 340 U | 340 U | 410 U | 410 U | 410 U |
| Fluoranthene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Pyrene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Butylbenzylphthalate | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzo(a)Anthracene | 340 U | 340 U | 410 U | 410 U | 410 U |
| 3,3'-Dichlorobenzidine | 680 U | 680 U | 810 U | 810 U | 810 U |
| Chrysene | 340 U | 340 U | 410 U | 410 U | 410 U |
| bis(2-Ethylhexyl)Phthalat | 340 U | 340 U | 410 U | 410 U | 410 U |
| Di-n-octylphthalate | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzo(b)Fluoranthene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzo(k)Fluoranthene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzo(a)Pyrene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Indeno(1,2,3-cd)Pyrene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Dibenz(a,h)Anthracene | 340 U | 340 U | 410 U | 410 U | 410 U |
| Benzo(g,h,i)Perylene | 340 U | 340 U | 410 U | 410 U | 410 U |

IANG SITE 1 SOIL SAMPLES

| | | | | | |
|---|---|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-4/<br>MW-3-S2 | IANG-1<br>SB-5/<br>MW-4-S1 | IANG-1<br>SB-5/<br>MW-4-S2 | IANG-1<br>SB-6/<br>MW-5-S1 | IANG-1<br>SB-6/<br>MW-5-S2 |
| Date Sampled: | 7-AUG-90 | 8-AUG-90 | 8-AUG-90 | 9-AUG-90 | 9-AUG-90 |
| Lab ID: | 2125-09 | 2125-01 | 2125-02 | 2136-05 | 2136-06 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |

Miscellaneous Parameters

| | | | | | |
|---|---|---|---|---|---|
| Date Analyzed: | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 1600 | 780 | 3100 | 20 | 12 U |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| SAMPLE ID: | IANG-1 SB-1-S1 | IANG-1 SB-1-S2 | IANG-1 SB-3/ MW-2-S1 | IANG-1 SB-3/ MW-2-S2 | IANG-1 SB-4/ MW-3-S1 |
|---|---|---|---|---|---|
| Date Sampled: | 31-JUL-90 | 31-JUL-90 | 6-AUG-90 | 6-AUG-90 | 7-AUG-90 |
| Lab ID: | 2091-01 | 2091-02 | 2125-05 | 2125-06 | 2125-08 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |
| Associated Samples: | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 |
| **Volatile Organics (ug/kg)** | | | | | |
| Date Analyzed: | 13-AUG-90 | 9-AUG-90 | 17-AUG-90 | 17-AUG-90 | 17-AUG-90 |
| Benzene | 330 | 5000 J | 370 U | 110 U | 330 U |
| Ethyl Benzene | 16000 | 42000 J | 1100 | 220 | 7900 |
| Toluene | 10000 | 61000 J | 1800 | 220 U | 5100 |
| Xylenes | 38000 | 100000 J | 15000 | 2200 | 24000 |
| Chlorobenzene | 500 U | 1800 UJ | 750 U | 220 U | 670 U |
| 1,2 Dichlorobenzene | 1000 U | 3600 UJ | 1500 U | 430 U | 1300 U |
| 1,3 Dichlorobenzene | 1000 U | 3600 UJ | 1500 U | 430 U | 1300 U |
| 1,4 Dichlorobenzene | 750 U | 2700 UJ | 1100 U | 320 U | 1000 U |
| **Semi-Volatile Organics (ug/kg)** | | | | | |
| Date Analyzed: | 3-AUG-90 | 3-AUG-90 | 13-AUG-90 | 13-AUG-90 | 13-AUG-90 |
| N-Nitroso-Dimethylamine | 340 U | 350 U | 340 U | 400 U | 340 U |
| Phenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Chloroethyl)ether | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Chlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,3-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,4-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzyl Alcohol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,2-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-chloroisopropyl)Eth | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| N-Nitroso-Di-n-Propylamin | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachloroethane | 340 U | 350 U | 340 U | 400 U | 340 U |
| Nitrobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Isophorone | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Nitrophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dimethylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Chloroethoxy)methan | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dichlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzoic Acid | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 1,2,4-Trichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Naphthalene | 820 | 1800 | 340 U | 400 U | 1100 |
| 4-Chloroaniline | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachlorobutadiene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Chloro-3-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Methylnaphthalene | 1200 | 2500 | 340 U | 400 U | 1600 |
| Hexachlorocyclopentadiene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4,6-Trichlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4,5-Trichlorophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 2-Chloronaphthalene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Nitroaniline | 340 U | 350 U | 340 U | 400 U | 340 U |
| Dimethylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Acenaphthylene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,6-Dinitrotoluene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 3-Nitroaniline | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Acenaphthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dinitrophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Dibenzofuran | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Nitrophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 2,4-Dinitrotoluene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Fluorene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Diethylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Chlorophenyl-phenylethe | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Nitroaniline | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 4,6-Dinitro-2-Methylpheno | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| N-Nitrosodiphenylamine | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Bromophenyl-phenylether | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Pentachlorophenol | 340 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Phenanthrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Di-n-Butylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Butylbenzylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(a)Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 3,3'-Dichlorobenzidine | 680 U | 710 U | 680 U | 800 U | 690 U |
| Chrysene | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Ethylhexyl)Phthalat | 340 U | 350 U | 340 U | 400 U | 340 U |
| Di-n-octylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(b)Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(k)Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(a)Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Indeno(1,2,3-cd)Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Dibenz(a,h)Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(g,h,i)Perylene | 340 U | 350 U | 340 U | 400 U | 340 U |

IANG SITE 1 SOIL SAMPLES

| SAMPLE ID: | IANG-1 SB-1-S1 | IANG-1 SB-1-S2 | IANG-1 SB-3/ MW-2-S1 | IANG-1 SB-3/ MW-2-S2 | IANG-1 SB-4/ MW-3-S1 |
|---|---|---|---|---|---|
| Date Sampled: | 31-JUL-90 | 31-JUL-90 | 6-AUG-90 | 6-AUG-90 | 7-AUG-90 |
| Lab ID: | 2091-01 | 2091-02 | 2125-05 | 2125-06 | 2125-08 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |
| **Miscellaneous Parameters** | | | | | |
| Date Analyzed: | 6-AUG-90 | 6-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 730 | 1700 | 10 U | 29 | 920 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

IANG SITE 1 SOIL SAMPLES SEMI-VOLATILES VOLATILES TPH RADIOLOGICAL PARAMETERS

| | | | | | |
|---|---|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-1-S1 | IANG-1<br>SB-1-S2 | IANG-1<br>SB-3/<br>MW-2-S1 | IANG-1<br>SB-3/<br>MW-2-S2 | IANG-1<br>SB-4/<br>MW-3-S1 |
| Date Sampled: | 31-JUL-90 | 31-JUL-90 | 6-AUG-90 | 6-AUG-90 | 7-AUG-90 |
| Lab ID: | 2091-01 | 2091-02 | 2125-05 | 2125-06 | 2125-08 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |
| Associated Samples: | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 | TB-1<br>RB-1 |
| **Volatile Organics (ug/kg)** | | | | | |
| Date Analyzed: | 13-AUG-90 | 9-AUG-90 | 17-AUG-90 | 17-AUG-90 | 17-AUG-90 |
| Benzene | 330 | 5000 J | 370 U | 110 U | 330 U |
| Ethyl Benzene | 16000 | 42000 J | 1100 | 220 | 7900 |
| Toluene | 10000 | 61000 J | 1800 | 550 U | 5100 |
| Xylenes | 38000 | 100000 J | 15000 | 2200 | 24000 |
| Chlorobenzene | 500 U | 1800 UJ | 750 U | 220 U | 670 U |
| 1,2 Dichlorobenzene | 1000 U | 3600 UJ | 1500 U | 430 U | 1300 U |
| 1,3 Dichlorobenzene | 1000 U | 3600 UJ | 1500 U | 430 U | 1300 U |
| 1,4 Dichlorobenzene | 750 U | 2700 UJ | 1100 U | 320 U | 1000 U |
| **Semi-Volatile Organics (ug/kg)** | | | | | |
| Date Analyzed: | 3-AUG-90 | 3-AUG-90 | 13-AUG-90 | 13-AUG-90 | 13-AUG-90 |
| N-Nitroso-Dimethylamine | 340 U | 350 U | 340 U | 400 U | 340 U |
| Phenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Chloroethyl)ether | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Chlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,3-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,4-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzyl Alcohol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 1,2-Dichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-chloroisopropyl)Eth | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| N-Nitroso-Di-n-Propylamin | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachloroethane | 340 U | 350 U | 340 U | 400 U | 340 U |
| Nitrobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Isophorone | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Nitrophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dimethylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Chloroethoxy)methan | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dichlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzoic Acid | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 1,2,4-Trichlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Naphthalene | 820 | 1800 | 340 U | 400 U | 1100 |
| 4-Chloroaniline | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachlorobutadiene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Chloro-3-Methylphenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Methylnaphthalene | 1400 | 2500 | 340 U | 400 U | 1600 |
| Hexachlorocyclopentadiene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4,6-Trichlorophenol | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4,5-Trichlorophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 2-Chloronaphthalene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2-Nitroaniline | 340 U | 350 U | 340 U | 400 U | 340 U |
| Dimethylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Acenaphthylene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,6-Dinitrotoluene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 3-Nitroaniline | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Acenaphthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 2,4-Dinitrophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Dibenzofuran | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Nitrophenol | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 2,4-Dinitrotoluene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Fluorene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Diethylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Chlorophenyl-phenylethe | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Nitroaniline | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| 4,6-Dinitro-2-Methylpheno | 1600 U | 1700 U | 1700 U | 1900 U | 1700 U |
| N-Nitrosodiphenylamine | 340 U | 350 U | 340 U | 400 U | 340 U |
| 4-Bromophenyl-phenylether | 340 U | 350 U | 340 U | 400 U | 340 U |
| Hexachlorobenzene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Pentachlorophenol | 340 U | 1700 U | 1700 U | 1900 U | 1700 U |
| Phenanthrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Di-n-Butylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Butylbenzylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(a)Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| 3,3'-Dichlorobenzidine | 680 U | 710 U | 680 U | 800 U | 690 U |
| Chrysene | 340 U | 350 U | 340 U | 400 U | 340 U |
| bis(2-Ethylhexyl)Phthalat | 340 U | 350 U | 340 U | 400 U | 340 U |
| Di-n-octylphthalate | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(b)Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(k)Fluoranthene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(a)Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Indeno(1,2,3-cd)Pyrene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Dibenz(a,h)Anthracene | 340 U | 350 U | 340 U | 400 U | 340 U |
| Benzo(g,h,i)Perylene | 340 U | 350 U | 340 U | 400 U | 340 U |

IANG SITE 1 SOIL SAMPLES

| | | | | | |
|---|---|---|---|---|---|
| SAMPLE ID: | IANG-1<br>SB-1-S1 | IANG-1<br>SB-1-S2 | IANG-1<br>SB-3/<br>MW-2-S1 | IANG-1<br>SB-3/<br>MW-2-S2 | IANG-1<br>SB-4/<br>MW-3-S1 |
| Date Sampled: | 31-JUL-90 | 31-JUL-90 | 6-AUG-90 | 6-AUG-90 | 7-AUG-90 |
| Lab ID: | 2091-01 | 2091-02 | 2125-05 | 2125-06 | 2125-08 |
| Matrix: | Soil | Soil | Soil | Soil | Soil |
| **Miscellaneous Parameters** | | | | | |
| Date Analyzed: | 6-AUG-90 | 6-AUG-90 | 27-AUG-90 | 27-AUG-90 | 27-AUG-90 |
| TPH (mg/kg) | 730 | 1700 | 10 U | 29 | 920 |

Footnotes:
J--the value reported is an estimated concentration.
U--the compound was analyzed for, but not detected.

.IANG SITES 1 AND 2 WATER SAMPLE DUPLICATES

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>MW-6 | IANG-1<br>MW-10 | IANG-1<br>MW-8 |
| Date Sampled: | 15-Aug-90 | 15-Aug-90 | 15-Aug-90 |
| Lab ID: | | DUPLICATE<br>OF MW-6 | |
| Matrix: | Water | Water | Water |

==========================================================================

| | | | |
|---|---|---|---|
| DATE ANALYZED | 25-AUG-90 | 25-AUG-90 | 25-AUG-90 |
| Volatile Organics (ug/l) | | | |
| Benzene | 1 U | -- | 1 U |
| Ethyl Benzene | 2 U | -- | 2 U |
| Toluene | 2 U | -- | 2 U |
| Xylenes | 2 U | -- | 2 U |
| Chlorobenzene | 2 U | -- | 2 U |
| 1,2 Dichlorobenzene | 2 U | -- | 2 U |
| 1,3 Dichlorobenzene | 2 U | -- | 2 U |
| 1,4 Dichlorobenzene | 3 U | -- | 3 U |

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| | | | |
|---|---|---|---|
| Semi-Volatile Organics (ug/l) | | | |
| DATE ANALYZED | 24-AUG-90 | --- | 24-AUG-90 |
| N-Nitroso-Dimethylamine | 20 U | -- | 20 U |
| Phenol | 20 U | -- | 20 U |
| bis(2-Chloroethyl)ether | 20 U | -- | 20 U |
| 2-Chlorophenol | 20 U | -- | 20 U |
| 1,3-Dichlorobenzene | 20 U | -- | 20 U |
| 1,4-Dichlorobenzene | 20 U | -- | 20 U |
| Benzyl Alcohol | 20 U | -- | 20 U |
| 1,2-Dichlorobenzene | 20 U | -- | 20 U |
| 2-Methylphenol | 20 U | -- | 20 U |
| bis(2-Chloroisopropyl)Ether | 20 U | -- | 20 U |
| 4-Methylphenol | 20 U | -- | 20 U |
| N-Nitroso-Di-n-Propylamine | 20 U | -- | 20 U |
| Hexachloroethane | 20 U | -- | 20 U |
| Nitrobenzene | 20 U | -- | 20 U |
| Isophorone | 20 U | -- | 20 U |
| 2-Nitrophenol | 20 U | -- | 20 U |
| 2,4-Dimethylphenol | 20 U | -- | 20 U |
| bis(2-Chloroethoxy)methane | 20 U | -- | 20 U |
| 2,4-Dichlorophenol | 20 U | -- | 20 U |
| Benzoic Acid | 100 U | -- | 100 U |
| 1,2,4-Trichlorobenzene | 20 U | -- | 20 U |
| Naphthalene | 20 U | -- | 20 U |
| 4-Chloroaniline | 20 U | -- | 20 U |
| Hexachlorobutadiene | 20 U | -- | 20 U |
| 4-Chloro-3-Methylphenol | 20 U | -- | 20 U |
| 2-Methylnaphthalene | 20 U | -- | 20 U |
| Hexachlorocyclopentadiene | 20 U | -- | 20 U |
| 2,4,6-Trichlorophenol | 20 U | -- | 20 U |
| 2,4,5-Trichlorophenol | 100 U | -- | 100 U |
| 2-Chloronaphthalene | 20 U | -- | 20 U |
| 2-Nitroaniline | 100 U | -- | 100 U |
| Dimethylphthalate | 20 U | -- | 20 U |
| Acenaphthylene | 20 U | -- | 20 U |
| 2,6-Dinitrotoluene | 20 U | -- | 20 U |
| 3-Nitroaniline | 100 U | -- | 100 U |
| Acenaphthene | 20 U | -- | 20 U |
| 2,4-Dinitrophenol | 100 U | -- | 100 U |
| Dibenzofuran | 20 U | -- | 20 U |
| 4-Nitrophenol | 100 U | -- | 100 U |
| 2,4-Dinitrotoluene | 20 U | -- | 20 U |
| Fluorene | 20 U | -- | 20 U |
| Diethylphthalate | 20 U | -- | 20 U |
| 4-Chlorophenyl-phenylether | 20 U | -- | 20 U |
| 4-Nitroaniline | 100 U | -- | 100 U |
| 4,6-Dinitro-2-Methylphenol | 100 U | -- | 100 U |
| N-Nitrosodiphenylamine | 20 U | -- | 20 U |
| 4-Bromophenyl-phenylether | 20 U | -- | 20 U |
| Hexachlorobenzene | 20 U | -- | 20 U |
| Pentachlorophenol | 100 U | -- | 100 U |
| Phenanthrene | 20 U | -- | 20 U |
| Anthracene | 20 U | -- | 20 U |
| Di-n-Butylphthalate | 20 U | -- | 20 U |
| Fluoranthene | 20 U | -- | 20 U |
| Pyrene | 20 U | -- | 20 U |
| Butylbenzylphthalate | 20 U | -- | 20 U |
| Benzo(a)Anthracene | 20 U | -- | 20 U |
| 3,3'-Dichlorobenzidine | 40 U | -- | 40 U |
| Chrysene | 20 U | -- | 20 U |
| bis(2-Ethylhexyl)Phthalate | 20 U | -- | 20 U |
| Di-n-octylphthalate | 20 U | -- | 20 U |
| Benzo(b)Fluoranthene | 20 U | -- | 20 U |
| Benzo(k)Fluoranthene | 20 U | -- | 20 U |
| Benzo(a)Pyrene | 20 U | -- | 20 U |
| Indeno(1,2,3-cd)Pyrene | 20 U | -- | 20 U |
| Dibenz(a,h)Anthracene | 20 U | -- | 20 U |
| Benzo(g,h,i)Perylene | 20 U | -- | 20 U |

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MISCELLANEOUS PARAMETERS

IANG SITES 1 AND 2 WATER SAMPLE DUPLICATES

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>MW-6 | IANG-1<br>MW-10 | IANG-1<br>MW-8 |
| Date Sampled: | 15-Aug-90 | 15-Aug-90 | 15-Aug-90 |
| Lab ID: | | DUPLICATE<br>OF MW-6 | |
| Matrix: | Water | Water | Water |

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| | | | |
|---|---|---|---|
| DATE ANALYZED | 27-AUG-90 | --- | 27-AUG-90 |
| TPH (mg/l) | 1 U | -- | 1 U |
| .Radiological Parameters (pCi/l) | | | |
| Gross Alpha | 21+/-7 | 20+/-7 | -- |
| Gross Beta | 32+/-7 | 43+/-7 | -- |
| Radium-226 | 17+/-7.8 | 7.9+/-4.2 | -- |
| Radium-228 | 1 U | 1 U | -- |

IANG SITES 1 AND 2 WATER SAMPL

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>MW-9 | IANG-2<br>MW-5 | IANG-2<br>MW-6 |
| Date Sampled: | 15-Aug-90 | 14-Aug-90 | 14-Aug-90 |
| Lab ID: | DUPLICATE<br>OF MW-8 | | DUPLICATE<br>OF MW-5 |
| Matrix: | Water | Water | Water |

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| | | | |
|---|---|---|---|
| DATE ANALYZED | 25-AUG-90 | 28-AUG-90 | 28-AUG-90 |
| **Volatile Organics (ug/l)** | | | |
| Benzene | 1 U | -- | -- |
| Ethyl Benzene | 2 U | -- | -- |
| Toluene | 2 U | -- | -- |
| Xylenes | 2 U | -- | -- |
| Chlorobenzene | 2 U | -- | -- |
| 1,2 Dichlorobenzene | 2 U | -- | -- |
| 1,3 Dichlorobenzene | 2 U | -- | -- |
| 1,4 Dichlorobenzene | 3 U | -- | -- |

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Semi-Volatile Organics (ug/l)

| | | | |
|---|---|---|---|
| DATE ANALYZED | 24-AUG-90 | --- | --- |
| N-Nitroso-Dimethylamine | 20 U | -- | -- |
| Phenol | 20 U | -- | -- |
| bis(2-Chloroethyl)ether | 20 U | -- | -- |
| 2-Chlorophenol | 20 U | -- | -- |
| 1,3-Dichlorobenzene | 20 U | -- | -- |
| 1,4-Dichlorobenzene | 20 U | -- | -- |
| Benzyl Alcohol | 20 U | -- | -- |
| 1,2-Dichlorobenzene | 20 U | -- | -- |
| 2-Methylphenol | 20 U | -- | -- |
| bis(2-chloroisopropyl)Ether | 20 U | -- | -- |
| 4-Methylphenol | 20 U | -- | -- |
| N-Nitroso-Di-n-Propylamine | 20 U | -- | -- |
| Hexachloroethane | 20 U | -- | -- |
| Nitrobenzene | 20 U | -- | -- |
| Isophorone | 20 U | -- | -- |
| 2-Nitrophenol | 20 U | -- | -- |
| 2,4-Dimethylphenol | 20 U | -- | -- |
| bis(2-Chloroethoxy)methane | 20 U | -- | -- |
| 2,4-Dichlorophenol | 20 U | -- | -- |
| Benzoic Acid | 100 U | -- | -- |
| 1,2,4-Trichlorobenzene | 20 U | -- | -- |
| Naphthalene | 20 U | -- | -- |
| 4-Chloroaniline | 20 U | -- | -- |
| Hexachlorobutadiene | 20 U | -- | -- |
| 4-Chloro-3-Methylphenol | 20 U | -- | -- |
| 2-Methylnaphthalene | 20 U | -- | -- |
| Hexachlorocyclopentadiene | 20 U | -- | -- |
| 2,4,6-Trichlorophenol | 20 U | -- | -- |
| 2,4,5-Trichlorophenol | 100 U | -- | -- |
| 2-Chloronaphthalene | 20 U | -- | -- |
| 2-Nitroaniline | 100 U | -- | -- |
| Dimethylphthalate | 20 U | -- | -- |
| Acenaphthylene | 20 U | -- | -- |
| 2,6-Dinitrotoluene | 20 U | -- | -- |
| 3-Nitroaniline | 100 U | -- | -- |
| Acenaphthene | 20 U | -- | -- |
| 2,4-Dinitrophenol | 100 U | -- | -- |
| Dibenzofuran | 20 U | -- | -- |
| 4-Nitrophenol | 100 U | -- | -- |
| 2,4-Dinitrotoluene | 20 U | -- | -- |
| Fluorene | 20 U | -- | -- |
| Diethylphthalate | 20 U | -- | -- |
| 4-Chlorophenyl-phenylether | 20 U | -- | -- |
| 4-Nitroaniline | 100 U | -- | -- |
| 4,6-Dinitro-2-Methylphenol | 100 U | -- | -- |
| N-Nitrosodiphenylamine | 20 U | -- | -- |
| 4-Bromophenyl-phenylether | 20 U | -- | -- |
| Hexachlorobenzene | 20 U | -- | -- |
| Pentachlorophenol | 100 U | -- | -- |
| Phenanthrene | 20 U | -- | -- |
| Anthracene | 20 U | -- | -- |
| Di-n-Butylphthalate | 20 U | -- | -- |
| Fluoranthene | 20 U | -- | -- |
| Pyrene | 20 U | -- | -- |
| Butylbenzylphthalate | 20 U | -- | -- |
| Benzo(a)Anthracene | 20 U | -- | -- |
| 3,3'-Dichlorobenzidine | 20 U | -- | -- |
| Chrysene | 20 U | -- | -- |
| bis(2-Ethylhexyl)Phthalate | 20 U | -- | -- |
| Di-n-octylphthalate | 20 U | -- | -- |
| Benzo(b)Fluoranthene | 20 U | -- | -- |
| Benzo(k)Fluoranthene | 20 U | -- | -- |
| Benzo(a)Pyrene | 20 U | -- | -- |
| Indeno(1,2,3-cd)Pyrene | 20 U | -- | -- |
| Dibenz(a,h)Anthracene | 20 U | -- | -- |
| Benzo(g,h,i)Perylene | 20 U | -- | -- |

==================================================================

MISCELLANEOUS PARAMETERS

IANG SITES 1 AND 2 WATER SAMPL

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>MW-9 | IANG-2<br>MW-5 | IANG-2<br>MW-6 |
| Date Sampled: | 15-Aug-90 | 14-Aug-90 | 14-Aug-90 |
| Lab ID: | DUPLICATE<br>OF MW-8 | | DUPLICATE<br>OF MW-5 |
| Matrix: | Water | Water | Water |

==================================================================

| | | | |
|---|---|---|---|
| DATE ANALYZED | 27-AUG-90 | --- | --- |
| TPH (mg/l) | 1 U | -- | -- |
| **Radiological Parameters (pCi/l** | | | |
| Gross Alpha | -- | 9+/-8* | 11+/-8* |
| Gross Beta | -- | 36+/-12 | 22+/-11 |
| Radium-226 | -- | 0.6 U | 1.0+/-0.5 |
| Radium-228 | -- | 1 U | 1 U |

IANG SITES 1 AND 2 WATER SAMPL

| Client's ID: | IANG-1<br>MW-9 | IANG-2<br>MW-5 | IANG-2<br>MW-6 |
|---|---|---|---|
| Date Sampled: | 15-Aug-90 | 14-Aug-90 | 14-Aug-90 |
| Lab ID: | DUPLICATE<br>OF MW-8 | | DUPLICATE<br>OF MW-5 |
| Matrix: | Water | Water | Water |
| DATE ANALYZED | 25-AUG-90 | 28-AUG-90 | 28-AUG-90 |

Volatile Organics (ug/l)

| | | | |
|---|---|---|---|
| Benzene | 1 U | -- | -- |
| Ethyl Benzene | 2 U | -- | -- |
| Toluene | 2 U | -- | -- |
| Xylenes | 2 U | -- | -- |
| Chlorobenzene | 2 U | -- | -- |
| 1,2 Dichlorobenzene | 2 U | -- | -- |
| 1,3 Dichlorobenzene | 2 U | -- | -- |
| 1,4 Dichlorobenzene | 3 U | -- | -- |

Semi-Volatile Organics (ug/l)

| | | | |
|---|---|---|---|
| DATE ANALYZED | 24-AUG-90 | --- | --- |
| N-Nitroso-Dimethylamine | 20 U | -- | -- |
| Phenol | 20 U | -- | -- |
| bis(2-Chloroethyl)ether | 20 U | -- | -- |
| 2-Chlorophenol | 20 U | -- | -- |
| 1,3-Dichlorobenzene | 20 U | -- | -- |
| 1,4-Dichlorobenzene | 20 U | -- | -- |
| Benzyl Alcohol | 20 U | -- | -- |
| 1,2-Dichlorobenzene | 20 U | -- | -- |
| 2-Methylphenol | 20 U | -- | -- |
| bis(2-chloroisopropyl)Ether | 20 U | -- | -- |
| 4-Methylphenol | 20 U | -- | -- |
| N-Nitroso-Di-n-Propylamine | 20 U | -- | -- |
| Hexachloroethane | 20 U | -- | -- |
| Nitrobenzene | 20 U | -- | -- |
| Isophorone | 20 U | -- | -- |
| 2-Nitrophenol | 20 U | -- | -- |
| 2,4-Dimethylphenol | 20 U | -- | -- |
| bis(2-Chloroethoxy)methane | 20 U | -- | -- |
| 2,4-Dichlorophenol | 20 U | -- | -- |
| Benzoic Acid | 100 U | -- | -- |
| 1,2,4-Trichlorobenzene | 20 U | -- | -- |
| Naphthalene | 20 U | -- | -- |
| 4-Chloroaniline | 20 U | -- | -- |
| Hexachlorobutadiene | 20 U | -- | -- |
| 4-Chloro-3-Methylphenol | 20 U | -- | -- |
| 2-Methylnaphthalene | 20 U | -- | -- |
| Hexachlorocyclopentadiene | 20 U | -- | -- |
| 2,4,6-Trichlorophenol | 20 U | -- | -- |
| 2,4,5-Trichlorophenol | 100 U | -- | -- |
| 2-Chloronaphthalene | 20 U | -- | -- |
| 2-Nitroaniline | 100 U | -- | -- |
| Dimethylphthalate | 20 U | -- | -- |
| Acenaphthylene | 20 U | -- | -- |
| 2,6-Dinitrotoluene | 20 U | -- | -- |
| 3-Nitroaniline | 100 U | -- | -- |
| Acenaphthene | 20 U | -- | -- |
| 2,4-Dinitrophenol | 100 U | -- | -- |
| Dibenzofuran | 20 U | -- | -- |
| 4-Nitrophenol | 100 U | -- | -- |
| 2,4-Dinitrotoluene | 20 U | -- | -- |
| Fluorene | 20 U | -- | -- |
| Diethylphthalate | 20 U | -- | -- |
| 4-Chlorophenyl-phenylether | 20 U | -- | -- |
| 4-Nitroaniline | 100 U | -- | -- |
| 4,6-Dinitro-2-Methylphenol | 100 U | -- | -- |
| N-Nitrosodiphenylamine | 20 U | -- | -- |
| 4-Bromophenyl-phenylether | 20 U | -- | -- |
| Hexachlorobenzene | 20 U | -- | -- |
| Pentachlorophenol | 100 U | -- | -- |
| Phenanthrene | 20 U | -- | -- |
| Anthracene | 20 U | -- | -- |
| Di-n-Butylphthalate | 20 U | -- | -- |
| Fluoranthene | 20 U | -- | -- |
| Pyrene | 20 U | -- | -- |
| Butylbenzylphthalate | 20 U | -- | -- |
| Benzo(a)Anthracene | 20 U | -- | -- |
| 3,3'-Dichlorobenzidine | 40 U | -- | -- |
| Chrysene | 20 U | -- | -- |
| bis(2-Ethylhexyl)Phthalate | 20 U | -- | -- |
| Di-n-octylphthalate | 20 U | -- | -- |
| Benzo(b)Fluoranthene | 20 U | -- | -- |
| Benzo(k)Fluoranthene | 20 U | -- | -- |
| Benzo(a)Pyrene | 20 U | -- | -- |
| Indeno(1,2,3-cd)Pyrene | 20 U | -- | -- |
| Dibenz(a,h)Anthracene | 20 U | -- | -- |
| Benzo(g,h,i)Perylene | 20 U | -- | -- |

MISCELLANEOUS PARAMETERS

IANG SITES 1 AND 2 WATER SAMPL

| Client's ID: | IANG-1<br>MW-9 | IANG-2<br>MW-5 | IANG-2<br>MW-6 |
|---|---|---|---|
| Date Sampled: | 15-Aug-90 | 14-Aug-90 | 14-Aug-90 |
| Lab ID: | DUPLICATE<br>OF MW-8 | | DUPLICATE<br>OF MW-5 |
| Matrix: | Water | Water | Water |
| DATE ANALYZED | 27-AUG-90 | --- | --- |
| TPH (mg/l) | 1 U | -- | -- |

Radiological Parameters (pCi/l

| | | | |
|---|---|---|---|
| Gross Alpha | -- | 9+/-8* | 11+/-8* |
| Gross Beta | -- | 36+/-12 | 22+/-11 |
| Radium-226 | -- | 0.6 U | 1.0+/-0.5 |
| Radium-228 | -- | 1 U | 1 U |

IANG SITES 1 AND 2 TRIP/FIELD/RINSE BLANKS

| Client's ID: | IANG-1 TB1 | IANG-1 TB2 | IANG-1 TB3 |
|---|---|---|---|
| Date Sampled: | 10-Jul-90 | 07-Aug-90 | 08-Aug-90 |
| Lab ID: | 2091-04 | 2125-10 | 2125-04 |
| Matrix: | Water | Water | Water |

| Volatile Organics (ug/l) | | | |
|---|---|---|---|
| DATE ANALYZED | 13-AUG-90 | 17-AUG-90 | 17-AUG-90 |
| Benzene | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 2 U |
| Toluene | 2 U | 2 U | 2 U |
| Xylenes | 2 U | 2 U | 2 U |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 2 U | 2 U | 2 U |
| 1,3 Dichlorobenzene | 2 U | 2 U | 2 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |

| Semi-Volatile Organics (ug/l) | | | |
|---|---|---|---|
| DATE ANALYZED | -- | -- | -- |
| N-Nitroso-Dimethylamine | -- | -- | -- |
| Phenol | -- | -- | -- |
| bis(2-Chloroethyl)ether | -- | -- | -- |
| 2-Chlorophenol | -- | -- | -- |
| 1,3-Dichlorobenzene | -- | -- | -- |
| 1,4-Dichlorobenzene | -- | -- | -- |
| Benzyl Alcohol | -- | -- | -- |
| 1,2-Dichlorobenzene | -- | -- | -- |
| 2-Methylphenol | -- | -- | -- |
| bis(2-chloroisopropyl)Ether | -- | -- | -- |
| 4-Methylphenol | -- | -- | -- |
| N-Nitroso-Di-n-Propylamine | -- | -- | -- |
| Hexachloroethane | -- | -- | -- |
| Nitrobenzene | -- | -- | -- |
| Isophorone | -- | -- | -- |
| 2-Nitrophenol | -- | -- | -- |
| 2,4-Dimethylphenol | -- | -- | -- |
| bis(2-Chloroethoxy)methane | -- | -- | -- |
| 2,4-Dichlorophenol | -- | -- | -- |
| Benzoic Acid | -- | -- | -- |
| 1,2,4-Trichlorobenzene | -- | -- | -- |
| Naphthalene | -- | -- | -- |
| 4-Chloroaniline | -- | -- | -- |
| Hexachlorobutadiene | -- | -- | -- |
| 4-Chloro-3-Methylphenol | -- | -- | -- |
| 2-Methylnaphthalene | -- | -- | -- |
| Hexachlorocyclopentadiene | -- | -- | -- |
| 2,4,6-Trichlorophenol | -- | -- | -- |
| 2,4,5-Trichlorophenol | -- | -- | -- |
| 2-Chloronaphthalene | -- | -- | -- |
| 2-Nitroaniline | -- | -- | -- |
| Dimethylphthalate | -- | -- | -- |
| Acenaphthylene | -- | -- | -- |
| 2,6-Dinitrotoluene | -- | -- | -- |
| 3-Nitroaniline | -- | -- | -- |
| Acenaphthene | -- | -- | -- |
| 2,4-Dinitrophenol | -- | -- | -- |
| Dibenzofuran | -- | -- | -- |
| 4-Nitrophenol | -- | -- | -- |
| 2,4-Dinitrotoluene | -- | -- | -- |
| Fluorene | -- | -- | -- |
| Diethylphthalate | -- | -- | -- |
| 4-Chlorophenyl-phenylether | -- | -- | -- |
| 4-Nitroaniline | -- | -- | -- |
| 4,6-Dinitro-2-Methylphenol | -- | -- | -- |
| N-Nitrosodiphenylamine | -- | -- | -- |
| 4-Bromophenyl-phenylether | -- | -- | -- |
| Hexachlorobenzene | -- | -- | -- |
| Pentachlorophenol | -- | -- | -- |
| Phenanthrene | -- | -- | -- |
| Anthracene | -- | -- | -- |
| Di-n-Butylphthalate | -- | -- | -- |
| Fluoranthene | -- | -- | -- |
| Pyrene | -- | -- | -- |
| Butylbenzylphthalate | -- | -- | -- |
| Benzo(a)Anthracene | -- | -- | -- |
| 3,3'-Dichlorobenzidine | -- | -- | -- |
| Chrysene | -- | -- | -- |
| bis(2-Ethylhexyl)Phthalate | -- | -- | -- |
| Di-n-octylphthalate | -- | -- | -- |
| Benzo(b)Fluoranthene | -- | -- | -- |
| Benzo(k)Fluoranthene | -- | -- | -- |
| Benzo(a)Pyrene | -- | -- | -- |
| Indeno(1,2,3-cd)Pyrene | -- | -- | -- |
| Dibenz(a,h)Anthracene | -- | -- | -- |
| Benzo(g,h,i)Perylene | -- | -- | -- |

MISCELLANEOUS PARAMETERS

| Client's ID: | IANG-1 TB1 | IANG-1 TB2 | IANG-1 TB3 |
|---|---|---|---|
| DATE ANALYZED<br>Date Sampled: | ---- | ---- | ---- |
| Lab ID: | 2091-04 | 2125-10 | 2125-04 |
| Matrix: | Water | Water | Water |
| TPH (mg/kg) | ---- | ---- | ---- |
| Matrix:<br>Radiological Parameters | Water | Water | Water |
| DATE ANALYZED | ---- | --- | --- |
| Gross Alpha | -- | -- | -- |
| Gross Beta | -- | -- | -- |
| Radium-226 | -- | -- | -- |
| Radium-228 | -- | -- | -- |

Footnotes:
J--the value reported is an estimated concentration. This is used when the
U--the compound was analyzed for, but not detected.

IANG SITES 1 AND 2 TRIP/FIELD/

| Client's ID: | | IANG-1 TB4 | IANG-1 TB5 | IANG-1 TB6 | IANG-1 FB-1 (DIUF) |
|---|---|---|---|---|---|
| Date Sampled: | | 12-Aug-90 | 15-Aug-90 | 23-Aug-90 | 12-Aug-90 |
| Lab ID: | | 2136-15 | 2169-04 | 2195-02 | 2136-01 |
| Matrix: | | Water | Water | Water | Water |

Volatile Organics (ug/l)

| DATE ANALYZED | 90 | 17-AUG-90 | 25-AUG-90 | 31-AUG-90 | 17-AUG-90 |
|---|---|---|---|---|---|
| Benzene | U | 1 U | 1 U | 1 U | 1 U |
| Ethyl Benzene | U | 2 U | 2 U | 2 U | 2 U |
| Toluene | U | 2 U | 2 U | 2 U | 2 U |
| Xylenes | U | 2 U | 2 U | 2 U | 2 U |
| Chlorobenzene | U | 2 U | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | U | 2 U | 2 U | 2 U | 2 U |
| 1,3 Dichlorobenzene | U | 2 U | 2 U | 2 U | 2 U |
| 1,4 Dichlorobenzene | U | 3 U | 3 U | 3 U | 3 U |

Semi-Volatile Organics (ug/l)

| DATE ANALYZED | | | | |
|---|---|---|---|---|
| N-Nitroso-Dimethylamine | -- | -- | -- | 20 U |
| Phenol | -- | -- | -- | 20 U |
| bis(2-Chloroethyl)ether | -- | -- | -- | 20 U |
| 2-Chlorophenol | -- | -- | -- | 20 U |
| 1,3-Dichlorobenzene | -- | -- | -- | 20 U |
| 1,4-Dichlorobenzene | -- | -- | -- | 20 U |
| Benzyl Alcohol | -- | -- | -- | 20 U |
| 1,2-Dichlorobenzene | -- | -- | -- | 20 U |
| 2-Methylphenol | -- | -- | -- | 20 U |
| bis(2-chloroisopropyl)Ether | -- | -- | -- | 20 U |
| 4-Methylphenol | -- | -- | -- | 20 U |
| N-Nitroso-Di-n-Propylamine | -- | -- | -- | 20 U |
| Hexachloroethane | -- | -- | -- | 20 U |
| Nitrobenzene | -- | -- | -- | 20 U |
| Isophorone | -- | -- | -- | 20 U |
| 2-Nitrophenol | -- | -- | -- | 20 U |
| 2,4-Dimethylphenol | -- | -- | -- | 20 U |
| bis(2-Chloroethoxy)methane | -- | -- | -- | 20 U |
| 2,4-Dichlorophenol | -- | -- | -- | 20 U |
| Benzoic Acid | -- | -- | -- | 100 U |
| 1,2,4-Trichlorobenzene | -- | -- | -- | 20 U |
| Naphthalene | -- | -- | -- | 20 U |
| 4-Chloroaniline | -- | -- | -- | 20 U |
| Hexachlorobutadiene | -- | -- | -- | 20 U |
| 4-Chloro-3-Methylphenol | -- | -- | -- | 20 U |
| 2-Methylnaphthalene | -- | -- | -- | 20 U |
| hexachlorocyclopentadiene | -- | -- | -- | 20 U |
| 2,4,6-Trichlorophenol | -- | -- | -- | 20 U |
| 2,4,5-Trichlorophenol | -- | -- | -- | 100 U |
| 2-Chloronaphthalene | -- | -- | -- | 20 U |
| 2-Nitroaniline | -- | -- | -- | 100 U |
| Dimethylphthalate | -- | -- | -- | 20 U |
| Acenaphthylene | -- | -- | -- | 20 U |
| 2,6-Dinitrotoluene | -- | -- | -- | 20 U |
| 3-Nitroaniline | -- | -- | -- | 100 U |
| Acenaphthene | -- | -- | -- | 20 U |
| 2,4-Dinitrophenol | -- | -- | -- | 100 U |
| Dibenzofuran | -- | -- | -- | 20 U |
| 4-Nitrophenol | -- | -- | -- | 100 U |
| 2,4-Dinitrotoluene | -- | -- | -- | 20 U |
| Fluorene | -- | -- | -- | 20 U |
| Diethylphthalate | -- | -- | -- | 20 U |
| 4-Chlorophenyl-phenylether | -- | -- | -- | 20 U |
| 4-Nitroaniline | -- | -- | -- | 100 U |
| 4,6-Dinitro-2-Methylphenol | -- | -- | -- | 100 U |
| N-Nitrosodiphenylamine | -- | -- | -- | 20 U |
| 4-Bromophenyl-phenylether | -- | -- | -- | 20 U |
| Hexachlorobenzene | -- | -- | -- | 20 U |
| Pentachlorophenol | -- | -- | -- | 100 U |
| Phenanthrene | -- | -- | -- | 20 U |
| Anthracene | -- | -- | -- | 20 U |
| Di-n-Butylphthalate | -- | -- | -- | 20 U |
| Fluoranthene | -- | -- | -- | 20 U |
| Pyrene | -- | -- | -- | 20 U |
| Butylbenzylphthalate | -- | -- | -- | 20 U |
| Benzo(a)Anthracene | -- | -- | -- | 20 U |
| 3,3'-Dichlorobenzidine | -- | -- | -- | 40 U |
| Chrysene | -- | -- | -- | 20 U |
| bis(2-Ethylhexyl)Phthalate | -- | -- | -- | 20 U |
| Di-n-octylphthalate | -- | -- | -- | 20 U |
| Benzo(b)Fluoranthene | -- | -- | -- | 20 U |
| Benzo(k)Fluoranthene | -- | -- | -- | 20 U |
| Benzo(a)Pyrene | -- | -- | -- | 20 U |
| Indeno(1,2,3-cd)Pyrene | -- | -- | -- | 20 U |
| Dibenz(a,h)Anthracene | -- | -- | -- | 20 U |
| Benzo(g,h,i)Perylene | -- | -- | -- | 20 U |

MISCELLANEOUS PARAMETERS

| Client's ID: | IANG-1 TB4 | | IANG-1 TB5 | IANG-1 TB5 | IANG-1 FB-1 |
|---|---|---|---|---|---|
| DATE ANALYZED<br>Date Sampled: | ---- | -- | ---- | - - | 23-AUG-90<br>12-Aug-90 |
| Lab ID: | 2136-15 | | 2169-04 | 2195-02 | 2136-01 |
| Matrix: | Water | | Water | Water | Water |
| TPH (mg/kg) | ---- | -- | ---- | ---- | 1 U |
| Matrix:<br>Radiological Parameters | Water | | Water | Water | Water |
| DATE ANALYZED | --- | - | --- | ---- | |
| Gross Alpha | -- | | -- | -- | 2 U |
| Gross Beta | -- | | -- | -- | 3 U |
| Radium-226 | -- | | -- | -- | 1.0+/-0.6 |
| Radium-228 | -- | | -- | -- | 1 U |

Footnotes:
J--the value reported is an he compound is detected at an amount less than the reporting limit.
--the compound was analyzed

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | | | |
|---|---|---|---|---|---|
| Client's ID: | | IANG-1 TB4 | IANG-1 TB5 | IANG-1 TB6 | IANG-1 FB-1 (DIUF) |
| Date Sampled: | | 12-Aug-90 | 15-Aug-90 | 23-Aug-90 | 12-Aug-90 |
| Lab ID: | | 2136-15 | 2169-04 | 2195-02 | 2136-01 |
| Matrix: | | Water | Water | Water | Water |
| **Volatile Organics (ug/l)** | | | | | |
| DATE ANALYZED | 90 | 17-AUG-90 | 25-AUG-90 | 31-AUG-90 | 17-AUG-90 |
| Benzene | U | 1 U | 1 U | 1 U | 1 U |
| Ethyl Benzene | U | 2 U | 2 U | 2 U | 2 U |
| Toluene | U | 2 U | 2 U | 2 U | 2 U |
| Xylenes | U | 4 U | 4 U | 4 U | 4 U |
| Chlorobenzene | U | 2 U | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | U | 4 U | 4 U | 4 U | 4 U |
| 1,3 Dichlorobenzene | U | 4 U | 4 U | 4 U | 4 U |
| 1,4 Dichlorobenzene | U | 3 U | 3 U | 3 U | 3 U |
| **Semi-Volatile Organics (ug/l)** | | | | | |
| DATE ANALYZED | | | | | |
| N-Nitroso-Dimethylamine | | -- | -- | -- | 20 U |
| Phenol | | -- | -- | -- | 20 U |
| bis(2-Chloroethyl)ether | | -- | -- | -- | 20 U |
| 2-Chlorophenol | | -- | -- | -- | 20 U |
| 1,3-Dichlorobenzene | | -- | -- | -- | 20 U |
| 1,4-Dichlorobenzene | | -- | -- | -- | 20 U |
| Benzyl Alcohol | | -- | -- | -- | 20 U |
| 1,2-Dichlorobenzene | | -- | -- | -- | 20 U |
| 2-Methylphenol | | -- | -- | -- | 20 U |
| bis(2-chloroisopropyl)Ether | | -- | -- | -- | 20 U |
| 4-Methylphenol | | -- | -- | -- | 20 U |
| N-Nitroso-Di-n-Propylamine | | -- | -- | -- | 20 U |
| Hexachloroethane | | -- | -- | -- | 20 U |
| Nitrobenzene | | -- | -- | -- | 20 U |
| Isophorone | | -- | -- | -- | 20 U |
| 2-Nitrophenol | | -- | -- | -- | 20 U |
| 2,4-Dimethylphenol | | -- | -- | -- | 20 U |
| bis(2-Chloroethoxy)methane | | -- | -- | -- | 20 U |
| 2,4-Dichlorophenol | | -- | -- | -- | 20 U |
| Benzoic Acid | | -- | -- | -- | 100 U |
| 1,2,4-Trichlorobenzene | | -- | -- | -- | 20 U |
| Naphthalene | | -- | -- | -- | 20 U |
| 4-Chloroaniline | | -- | -- | -- | 20 U |
| Hexachlorobutadiene | | -- | -- | -- | 20 U |
| 4-Chloro-3-Methylphenol | | -- | -- | -- | 20 U |
| 2-Methylnaphthalene | | -- | -- | -- | 20 U |
| Hexachlorocyclopentadiene | | -- | -- | -- | 20 U |
| 2,4,6-Trichlorophenol | | -- | -- | -- | 20 U |
| 2,4,5-Trichlorophenol | | -- | -- | -- | 100 U |
| 2-Chloronaphthalene | | -- | -- | -- | 20 U |
| 2-Nitroaniline | | -- | -- | -- | 100 U |
| Dimethylphthalate | | -- | -- | -- | 20 U |
| Acenaphthylene | | -- | -- | -- | 20 U |
| 2,6-Dinitrotoluene | | -- | -- | -- | 20 U |
| 3-Nitroaniline | | -- | -- | -- | 100 U |
| Acenaphthene | | -- | -- | -- | 20 U |
| 2,4-Dinitrophenol | | -- | -- | -- | 100 U |
| Dibenzofuran | | -- | -- | -- | 20 U |
| 4-Nitrophenol | | -- | -- | -- | 100 U |
| 2,4-Dinitrotoluene | | -- | -- | -- | 20 U |
| Fluorene | | -- | -- | -- | 20 U |
| Diethylphthalate | | -- | -- | -- | 20 U |
| 4-Chlorophenyl-phenylether | | -- | -- | -- | 20 U |
| 4-Nitroaniline | | -- | -- | -- | 100 U |
| 4,6-Dinitro-2-Methylphenol | | -- | -- | -- | 100 U |
| N-Nitrosodiphenylamine | | -- | -- | -- | 20 U |
| 4-Bromophenyl-phenylether | | -- | -- | -- | 20 U |
| Hexachlorobenzene | | -- | -- | -- | 20 U |
| Pentachlorophenol | | -- | -- | -- | 100 U |
| Phenanthrene | | -- | -- | -- | 20 U |
| Anthracene | | -- | -- | -- | 20 U |
| Di-n-Butylphthalate | | -- | -- | -- | 20 U |
| Fluoranthene | | -- | -- | -- | 20 U |
| Pyrene | | -- | -- | -- | 20 U |
| Butylbenzylphthalate | | -- | -- | -- | 20 U |
| Benzo(a)Anthracene | | -- | -- | -- | 20 U |
| 3,3'-Dichlorobenzidine | | -- | -- | -- | 40 U |
| Chrysene | | -- | -- | -- | 20 U |
| bis(2-Ethylhexyl)Phthalate | | -- | -- | -- | 20 U |
| Di-n-octylphthalate | | -- | -- | -- | 20 U |
| Benzo(b)Fluoranthene | | -- | -- | -- | 20 U |
| Benzo(k)Fluoranthene | | -- | -- | -- | 20 U |
| Benzo(a)Pyrene | | -- | -- | -- | 20 U |
| Indeno(1,2,3-cd)Pyrene | | -- | -- | -- | 20 U |
| Dibenz(a,h)Anthracene | | -- | -- | -- | 20 U |
| Benzo(g,h,i)Perylene | | -- | -- | --- | 20 U |

MISCELLANEOUS PARAMETERS

| | | | | | |
|---|---|---|---|---|---|
| Client's ID: | IANG-1 TB4 | | IANG-1 TB5 | IANG-1 TB6 | IANG-1 FB-1 |
| DATE ANALYZED | ---- | -- | ---- | - - | 23-AUG-90 |
| Date Sampled: | | | | | 12-Aug-90 |
| Lab ID: | 2136-15 | | 2169-04 | 2195-02 | 2136-01 |
| Matrix: | Water | | Water | Water | Water |
| TPH (mg/kg) | ---- | -- | ---- | ---- | 1 U |
| Matrix: | Water | | Water | Water | Water |
| Radiological Parameters | | | | | |
| DATE ANALYZED | --- | - | --- | ---- | |
| Gross Alpha | -- | | -- | -- | 2 U |
| Gross Beta | -- | | -- | -- | 3 U |
| Radium-226 | -- | | -- | -- | 1.0+/-0.8 |
| Radium-228 | -- | | -- | -- | 1 U |

---

Footnotes:
J--the value reported is an he compound is detected at an amount less than the reporting limit.
--the compound was analyzed

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | | |
|---|---|---|---|---|
| Client's ID: | IANG-2<br>RB-2 | IANG-2<br>RB-3 | IANG-2<br>RB-4 | IANG-2<br>RB-5 |
| Date Sampled: | 28-Jul-90 | 29-Jul-90 | 30-Jul-90 | 14-Aug-90 |
| Lab ID: | -- | -- | -- | -- |
| Matrix: | Water | Water | Water | Water |

=========================================================================================

| Volatile Organics (ug/l) | | | | |
|---|---|---|---|---|
| DATE ANALYZED | ---- | --- | ---- | ---- |
| Benzene | -- | -- | -- | -- |
| Ethyl Benzene | -- | -- | -- | -- |
| Toluene | -- | -- | -- | -- |
| Xylenes | -- | -- | -- | -- |
| Chlorobenzene | -- | -- | -- | -- |
| 1,2 Dichlorobenzene | -- | -- | -- | -- |
| 1,3 Dichlorobenzene | -- | -- | -- | -- |
| 1,4 Dichlorobenzene | -- | -- | -- | -- |

=========================================================================================

| Semi-Volatile Organics (ug/l) | | | | |
|---|---|---|---|---|
| DATE ANALYZED | ---- | --- | ---- | ---- |
| N-Nitroso-Dimethylamine | -- | -- | -- | -- |
| Phenol | -- | -- | -- | -- |
| bis(2-Chloroethyl)ether | -- | -- | -- | -- |
| 2-Chlorophenol | -- | -- | -- | -- |
| 1,3-Dichlorobenzene | -- | -- | -- | -- |
| 1,4-Dichlorobenzene | -- | -- | -- | -- |
| Benzyl Alcohol | -- | -- | -- | -- |
| 1,2-Dichlorobenzene | -- | -- | -- | -- |
| 2-Methylphenol | -- | -- | -- | -- |
| bis(2-chloroisopropyl)Ether | -- | -- | -- | -- |
| 4-Methylphenol | -- | -- | -- | -- |
| N-Nitroso-Di-n-Propylamine | -- | -- | -- | -- |
| Hexachloroethane | -- | -- | -- | -- |
| Nitrobenzene | -- | -- | -- | -- |
| Isophorone | -- | -- | -- | -- |
| 2-Nitrophenol | -- | -- | -- | -- |
| 2,4-Dimethylphenol | -- | -- | -- | -- |
| bis(2-Chloroethoxy)methane | -- | -- | -- | -- |
| 2,4-Dichlorophenol | -- | -- | -- | -- |
| Benzoic Acid | -- | -- | -- | -- |
| 1,2,4-Trichlorobenzene | -- | -- | -- | -- |
| Naphthalene | -- | -- | -- | -- |
| 4-Chloroaniline | -- | -- | -- | -- |
| Hexachlorobutadiene | -- | -- | -- | -- |
| 4-Chloro-3-Methylphenol | -- | -- | -- | -- |
| 2-Methylnaphthalene | -- | -- | -- | -- |
| Hexachlorocyclopentadiene | -- | -- | -- | -- |
| 2,4,6-Trichlorophenol | -- | -- | -- | -- |
| 2,4,5-Trichlorophenol | -- | -- | -- | -- |
| 2-Chloronaphthalene | -- | -- | -- | -- |
| 2-Nitroaniline | -- | -- | -- | -- |
| Dimethylphthalate | -- | -- | -- | -- |
| Acenaphthylene | -- | -- | -- | -- |
| 2,6-Dinitrotoluene | -- | -- | -- | -- |
| 3-Nitroaniline | -- | -- | -- | -- |
| Acenaphthene | -- | -- | -- | -- |
| 2,4-Dinitrophenol | -- | -- | -- | -- |
| Dibenzofuran | -- | -- | -- | -- |
| 4-Nitrophenol | -- | -- | -- | -- |
| 2,4-Dinitrotoluene | -- | -- | -- | -- |
| Fluorene | -- | -- | -- | -- |
| Diethylphthalate | -- | -- | -- | -- |
| 4-Chlorophenyl-phenylether | -- | -- | -- | -- |
| 4-Nitroaniline | -- | -- | -- | -- |
| 4,6-Dinitro-2-Methylphenol | -- | -- | -- | -- |
| N-Nitrosodiphenylamine | -- | -- | -- | -- |
| 4-Bromophenyl-phenylether | -- | -- | -- | -- |
| Hexachlorobenzene | -- | -- | -- | -- |
| Pentachlorophenol | -- | -- | -- | -- |
| Phenanthrene | -- | -- | -- | -- |
| Anthracene | -- | -- | -- | -- |
| Di-n-Butylphthalate | -- | -- | -- | -- |
| Fluoranthene | -- | -- | -- | -- |
| Pyrene | -- | -- | -- | -- |
| Butylbenzylphthalate | -- | -- | -- | -- |
| Benzo(a)Anthracene | -- | -- | -- | -- |
| 3,3'-Dichlorobenzidine | -- | -- | -- | -- |
| Chrysene | -- | -- | -- | -- |
| bis(2-Ethylhexyl)Phthalate | -- | -- | -- | -- |
| Di-n-octylphthalate | -- | -- | -- | -- |
| Benzo(b)Fluoranthene | -- | -- | -- | -- |
| Benzo(k)Fluoranthene | -- | -- | -- | -- |
| Benzo(a)Pyrene | -- | -- | -- | -- |
| Indeno(1,2,3-cd)Pyrene | -- | -- | -- | -- |
| Dibenz(a,h)Anthracene | -- | -- | -- | -- |
| Benzo(g,h,i)Perylene | -- | -- | -- | -- |

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>FB-1<br>(TAP) | IANG-1<br>FB-2<br>(DIUF) | IANG-1<br>RB-1 |
| Date Sampled: | 12-Aug-90 | 23-Aug-90 | 31-Jul-90 |
| Lab ID: | 2136-04 | 2195-01 | 2091-03 |
| Matrix: | Water | Water | Water |

==========================================================================

Volatile Organics (ug/l)

| DATE ANALYZED | 17-AUG-90 | 31-AUG-90 | 13-AUG-90 |
|---|---|---|---|
| Benzene | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 2 U |
| Toluene | 2 U | 2 U | 2 U |
| Xylenes | 4 U | 4 U | 4 U |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |

==========================================================================

Semi-Volatile Organics (ug/l`

| DATE ANALYZED | -- | 29-AUG-90 | 6-AUG-90 |
|---|---|---|---|
| N-Nitroso-Dimethylamine | -- | 20 U | 20 U |
| Phenol | -- | 20 U | 20 U |
| bis(2-Chloroethyl)ether | -- | 20 U | 20 U |
| 2-Chlorophenol | -- | 20 U | 20 U |
| 1,3-Dichlorobenzene | -- | 20 U | 20 U |
| 1,4-Dichlorobenzene | -- | 20 U | 20 U |
| Benzyl Alcohol | -- | 20 U | 20 U |
| 1,2-Dichlorobenzene | -- | 20 U | 20 U |
| 2-Methylphenol | -- | 20 U | 20 U |
| bis(2-chloroisopropyl)Ether | -- | 20 U | 20 U |
| 4-Methylphenol | -- | 20 U | 20 U |
| N-Nitroso-Di-n-Propylamine | -- | 20 U | 20 U |
| Hexachloroethane | -- | 20 U | 20 U |
| Nitrobenzene | -- | 20 U | 20 U |
| Isophorone | -- | 20 U | 20 U |
| 2-Nitrophenol | -- | 20 U | 20 U |
| 2,4-Dimethylphenol | -- | 20 U | 20 U |
| bis(2-Chloroethoxy)methane | -- | 20 U | 20 U |
| 2,4-Dichlorophenol | -- | 20 U | 20 U |
| Benzoic Acid | -- | 100 U | 100 U |
| 1,2,4-Trichlorobenzene | -- | 20 U | 20 U |
| Naphthalene | -- | 20 U | 20 U |
| 4-Chloroaniline | -- | 20 U | 20 U |
| Hexachlorobutadiene | -- | 20 U | 20 U |
| 4-Chloro-3-Methylphenol | -- | 20 U | 20 U |
| 2-Methylnaphthalene | -- | 20 U | 20 U |
| Hexachlorocyclopentadiene | -- | 20 U | 20 U |
| 2,4,6-Trichlorophenol | -- | 20 U | 20 U |
| 2,4,5-Trichlorophenol | -- | 100 U | 100 U |
| 2-Chloronaphthalene | -- | 20 U | 20 U |
| 2-Nitroaniline | -- | 100 U | 100 U |
| Dimethylphthalate | -- | 20 U | 20 U |
| Acenaphthylene | -- | 20 U | 20 U |
| 2,6-Dinitrotoluene | -- | 20 U | 20 U |
| 3-Nitroaniline | -- | 100 U | 100 U |
| Acenaphthene | -- | 20 U | 20 U |
| 2,4-Dinitrophenol | -- | 100 U | 100 U |
| Dibenzofuran | -- | 20 U | 20 U |
| 4-Nitrophenol | -- | 100 U | 100 U |
| 2,4-Dinitrotoluene | -- | 20 U | 20 U |
| Fluorene | -- | 20 U | 20 U |
| Diethylphthalate | -- | 20 U | 20 U |
| 4-Chlorophenyl-phenylether | -- | 20 U | 20 U |
| 4-Nitroaniline | -- | 100 U | 100 U |
| 4,6-Dinitro-2-Methylphenol | -- | 100 U | 100 U |
| N-Nitrosodiphenylamine | -- | 20 U | 20 U |
| 4-Bromophenyl-phenylether | -- | 20 U | 20 U |
| Hexachlorobenzene | -- | 20 U | 20 U |
| Pentachlorophenol | -- | 100 U | 100 U |
| Phenanthrene | -- | 20 U | 20 U |
| Anthracene | -- | 20 U | 20 U |
| Di-n-Butylphthalate | -- | 20 U | 20 U |
| Fluoranthene | -- | 20 U | 20 U |
| Pyrene | -- | 20 U | 20 U |
| Butylbenzylphthalate | -- | 20 U | 20 U |
| Benzo(a)Anthracene | -- | 20 U | 20 U |
| 3,3'-Dichlorobenzidine | -- | 40 U | 40 U |
| Chrysene | -- | 20 U | 20 U |
| bis(2-Ethylhexyl)Phthalate | -- | 20 U | 20 U |
| Di-n-octylphthalate | -- | 20 U | 20 U |
| Benzo(b)Fluoranthene | -- | 20 U | 20 U |
| Benzo(k)Fluoranthene | -- | 20 U | 20 U |
| Benzo(a)Pyrene | -- | 20 U | 20 U |
| Indeno(1,2,3-cd)Pyrene | -- | 20 U | 20 U |
| Dibenz(a,h)Anthracene | -- | 20 U | 20 U |
| Benzo(g,h,i)Perylene | -- | 20 U | 20 U |

MISCELLANEOUS PARAMETERS

| | | |
|---|---|---|
| Client's ID: | IANG-1<br>FB-1 | IANG-1<br>FB-2 |
| DATE ANALYZED | | 31-AUG-90 |
| Date Sampled: | | 23-Aug-90 |
| Lab ID: | 2136-04 | 2195-01 |
| Matrix: | Water | Water |
| TPH (mg/kg) | ---- | 1 U |
| Matrix: | Water | Water |
| Radiological Parameters | | |
| DATE ANALYZED | | |
| Gross Alpha | 2 U | 2 U |
| Gross Beta | 10+/-6.3 | 4+/-6.3 |
| Radium-226 | 0.6 U | 0.6 U |
| Radium-228 | 1 U | 1 U |

Footnotes:
J--the value reported is an
U--the compound was analyzed

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1<br>FB-1<br>(TAP) | IANG-1<br>FB-2<br>(DIUE) | IANG-1<br>RB-1 |
| Date Sampled: | 12-Aug-90 | 23-Aug-90 | 31-Jul-90 |
| Lab ID: | 2136-04 | 2195-01 | 2091-03 |
| Matrix: | Water | Water | Water |

Volatile Organics (ug/l)

| DATE ANALYZED | 17-AUG-90 | 31-AUG-90 | 13-AUG-90 |
|---|---|---|---|
| Benzene | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 2 U |
| Toluene | 2 U | 2 U | 2 U |
| Xylenes | 2 U | 2 U | 2 U |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 2 U | 2 U | 2 U |
| 1,3 Dichlorobenzene | 2 U | 2 U | 2 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |

Semi-Volatile Organics (ug/l`

| DATE ANALYZED | -- | 29-AUG-90 | 6-AUG-90 |
|---|---|---|---|
| N-Nitroso-Dimethylamine | -- | 20 U | 20 U |
| Phenol | -- | 20 U | 20 U |
| bis(2-Chloroethyl)ether | -- | 20 U | 20 U |
| 2-Chlorophenol | -- | 20 U | 20 U |
| 1,3-Dichlorobenzene | -- | 20 U | 20 U |
| 1,4-Dichlorobenzene | -- | 20 U | 20 U |
| Benzyl Alcohol | -- | 20 U | 20 U |
| 1,2-Dichlorobenzene | -- | 20 U | 20 U |
| 2-Methylphenol | -- | 20 U | 20 U |
| bis(2-chloroisopropyl)Ether | -- | 20 U | 20 U |
| 4-Methylphenol | -- | 20 U | 20 U |
| N-Nitroso-Di-n-Propylamine | -- | 20 U | 20 U |
| Hexachloroethane | -- | 20 U | 20 U |
| Nitrobenzene | -- | 20 U | 20 U |
| Isophorone | -- | 20 U | 20 U |
| 2-Nitrophenol | -- | 20 U | 20 U |
| 2,4-Dimethylphenol | -- | 20 U | 20 U |
| bis(2-Chloroethoxy)methane | -- | 20 U | 20 U |
| 2,4-Dichlorophenol | -- | 20 U | 20 U |
| Benzoic Acid | -- | 100 U | 100 U |
| 1,2,4-Trichlorobenzene | -- | 20 U | 20 U |
| Naphthalene | -- | 20 U | 20 U |
| 4-Chloroaniline | -- | 20 U | 20 U |
| Hexachlorobutadiene | -- | 20 U | 20 U |
| 4-Chloro-3-Methylphenol | -- | 20 U | 20 U |
| 2-Methylnaphthalene | -- | 20 U | 20 U |
| Hexachlorocyclopentadiene | -- | 20 U | 20 U |
| 2,4,6-Trichlorophenol | -- | 20 U | 20 U |
| 2,4,5-Trichlorophenol | -- | 100 U | 100 U |
| 2-Chloronaphthalene | -- | 20 U | 20 U |
| 2-Nitroaniline | -- | 100 U | 100 U |
| Dimethylphthalate | -- | 20 U | 20 U |
| Acenaphthylene | -- | 20 U | 20 U |
| 2,6-Dinitrotoluene | -- | 20 U | 20 U |
| 3-Nitroaniline | -- | 100 U | 100 U |
| Acenaphthene | -- | 20 U | 20 U |
| 2,4-Dinitrophenol | -- | 100 U | 100 U |
| Dibenzofuran | -- | 20 U | 20 U |
| 4-Nitrophenol | -- | 100 U | 100 U |
| 2,4-Dinitrotoluene | -- | 20 U | 20 U |
| Fluorene | -- | 20 U | 20 U |
| Diethylphthalate | -- | 20 U | 20 U |
| 4-Chlorophenyl-phenylether | -- | 20 U | 20 U |
| 4-Nitroaniline | -- | 100 U | 100 U |
| 4,6-Dinitro-2-Methylphenol | -- | 100 U | 100 U |
| N-Nitrosodiphenylamine | -- | 20 U | 20 U |
| 4-Bromophenyl-phenylether | -- | 20 U | 20 U |
| Hexachlorobenzene | -- | 20 U | 20 U |
| Pentachlorophenol | -- | 100 U | 100 U |
| Phenanthrene | -- | 20 U | 20 U |
| Anthracene | -- | 20 U | 20 U |
| Di-n-Butylphthalate | -- | 20 U | 20 U |
| Fluoranthene | -- | 20 U | 20 U |
| Pyrene | -- | 20 U | 20 U |
| Butylbenzylphthalate | -- | 20 U | 20 U |
| Benzo(a)Anthracene | -- | 20 U | 20 U |
| 3,3'-Dichlorobenzidine | -- | 20 U | 20 U |
| Chrysene | -- | 20 U | 20 U |
| bis(2-Ethylhexyl)Phthalate | -- | 20 U | 20 U |
| Di-n-octylphthalate | -- | 20 U | 20 U |
| Benzo(b)Fluoranthene | -- | 20 U | 20 U |
| Benzo(k)Fluoranthene | -- | 20 U | 20 U |
| Benzo(a)Pyrene | -- | 20 U | 20 U |
| Indeno(1,2,3-cd)Pyrene | -- | 20 U | 20 U |
| Dibenz(a,h)Anthracene | -- | 20 U | 20 U |
| Benzo(g,h,i)Perylene | -- | 20 U | 20 U |

MISCELLANEOUS PARAMETERS

| | | |
|---|---|---|
| Client's ID: | IANG-1<br>FB-1 | IANG-1<br>FB-2 |
| DATE ANALYZED | | 31-AUG-90 |
| Date Sampled: | | 23-Aug-90 |
| Lab ID: | 2136-04 | 2195-01 |
| Matrix: | Water | Water |
| TPH (mg/kg) | ---- | 1 U |
| Matrix: | Water | Water |

Radiological Parameters

| DATE ANALYZED | | |
|---|---|---|
| Gross Alpha | 2 U | 2 U |
| Gross Beta | 10+/-3 | 4+/-3 |
| Radium-226 | 0.6 U | 0.6 U |
| Radium-228 | 1 U | 1 U |

Footnotes:
J--the value reported is an
U--the compound was analyzed

IANG SITES 1 AND 2 TRIP/FIELD/

| Client's ID: | IANG-2<br>FB-2<br>(TAP) | IANG-2<br>FB-2<br>(DIUF) | IANG-2<br>RB-1 |
|---|---|---|---|
| Date Sampled: | 14-Aug-90 | 14-Aug-90 | 27-Jul-90 |
| Lab ID: | -- | -- | -- |
| Matrix: | Water | Water | Water |
| **Volatile Organics (ug/l)** | | | |
| DATE ANALYZED | ---- | ---- | ---- |
| Benzene | -- | -- | -- |
| Ethyl Benzene | -- | -- | -- |
| Toluene | -- | -- | -- |
| Xylenes | -- | -- | -- |
| Chlorobenzene | -- | -- | -- |
| 1,2 Dichlorobenzene | -- | -- | -- |
| 1,3 Dichlorobenzene | -- | -- | -- |
| 1,4 Dichlorobenzene | -- | -- | - |
| **Semi-Volatile Organics (ug/l)** | | | |
| DATE ANALYZED | ---- | ---- | ---- |
| N-Nitroso-Dimethylamine | -- | -- | -- |
| Phenol | -- | -- | -- |
| bis(2-Chloroethyl)ether | -- | -- | -- |
| 2-Chlorophenol | -- | -- | -- |
| 1,3-Dichlorobenzene | -- | -- | -- |
| 1,4-Dichlorobenzene | -- | -- | -- |
| Benzyl Alcohol | -- | -- | -- |
| 1,2-Dichlorobenzene | -- | -- | -- |
| 2-Methylphenol | -- | -- | -- |
| bis(2-chloroisopropyl)Ether | -- | -- | -- |
| 4-Methylphenol | -- | -- | -- |
| N-Nitroso-Di-n-Propylamine | -- | -- | -- |
| Hexachloroethane | -- | -- | -- |
| Nitrobenzene | -- | -- | -- |
| Isophorone | -- | -- | -- |
| 2-Nitrophenol | -- | -- | -- |
| 2,4-Dimethylphenol | -- | -- | -- |
| bis(2-Chloroethoxy)methane | -- | -- | -- |
| 2,4-Dichlorophenol | -- | -- | -- |
| Benzoic Acid | -- | -- | -- |
| 1,2,4-Trichlorobenzene | -- | -- | -- |
| Naphthalene | -- | -- | -- |
| 4-Chloroaniline | -- | -- | -- |
| Hexachlorobutadiene | -- | -- | -- |
| 4-Chloro-3-Methylphenol | -- | -- | -- |
| 2-Methylnaphthalene | -- | -- | -- |
| Hexachlorocyclopentadiene | -- | -- | -- |
| 2,4,6-Trichlorophenol | -- | -- | -- |
| 2,4,5-Trichlorophenol | -- | -- | -- |
| 2-Chloronaphthalene | -- | -- | -- |
| 2-Nitroaniline | -- | -- | -- |
| Dimethylphthalate | -- | -- | -- |
| Acenaphthylene | -- | -- | -- |
| 2,6-Dinitrotoluene | -- | -- | -- |
| 3-Nitroaniline | -- | -- | -- |
| Acenaphthene | -- | -- | -- |
| 2,4-Dinitrophenol | -- | -- | -- |
| Dibenzofuran | -- | -- | -- |
| 4-Nitrophenol | -- | -- | -- |
| 2,4-Dinitrotoluene | -- | -- | -- |
| Fluorene | -- | -- | -- |
| Diethylphthalate | -- | -- | -- |
| 4-Chlorophenyl-phenylether | -- | -- | -- |
| 4-Nitroaniline | -- | -- | -- |
| 4,6-Dinitro-2-Methylphenol | -- | -- | -- |
| N-Nitrosodiphenylamine | -- | -- | -- |
| 4-Bromophenyl-phenylether | -- | -- | -- |
| Hexachlorobenzene | -- | -- | -- |
| Pentachlorophenol | -- | -- | -- |
| Phenanthrene | -- | -- | -- |
| Anthracene | -- | -- | -- |
| Di-n-Butylphthalate | -- | -- | -- |
| Fluoranthene | -- | -- | -- |
| Pyrene | -- | -- | -- |
| Butylbenzylphthalate | -- | -- | -- |
| Benzo(a)Anthracene | -- | -- | -- |
| 3,3'-Dichlorobenzidine | -- | -- | -- |
| Chrysene | -- | -- | -- |
| bis(2-Ethylhexyl)Phthalate | -- | -- | -- |
| Di-n-octylphthalate | -- | -- | -- |
| Benzo(b)Fluoranthene | -- | -- | -- |
| Benzo(k)Fluoranthene | -- | -- | -- |
| Benzo(a)Pyrene | -- | -- | -- |
| Indeno(1,2,3-cd)Pyrene | -- | -- | -- |
| Dibenz(a,h)Anthracene | -- | -- | -- |
| Benzo(g,h,i)Perylene | -- | -- | -- |

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | |
|---|---|---|---|
| Client's ID: | IANG-1 RB-2 | IANG-1 RB-4 | IANG-1 RB-5 |
| Date Sampled: | 10-Aug-90 | 08-Aug-90 | 12-Aug-90 |
| Lab ID: | 2136-02 | 2125-03 | 2136-03 |
| Matrix: | Water | Water | Water |

Volatile Organics (ug/l)

| DATE ANALYZED | 17-AUG-90 | 16-AUG-90 | 17-AUG-90 |
|---|---|---|---|
| Benzene | 1 U | 1 U | 1 U |
| Ethyl Benzene | 2 U | 2 U | 2 U |
| Toluene | 2 U | 2 U | 2 U |
| Xylenes | 4 U | 4 U | 4 U |
| Chlorobenzene | 2 U | 2 U | 2 U |
| 1,2 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,3 Dichlorobenzene | 4 U | 4 U | 4 U |
| 1,4 Dichlorobenzene | 3 U | 3 U | 3 U |

Semi-Volatile Organics (ug/l)

| DATE ANALYZED | -- | 10-AUG-90 | 17-AUG-90 |
|---|---|---|---|
| N-Nitroso-Dimethylamine | -- | 20 U | 20 U |
| Phenol | -- | 20 U | 20 U |
| bis(2-Chloroethyl)ether | -- | 20 U | 20 U |
| 2-Chlorophenol | -- | 20 U | 20 U |
| 1,3-Dichlorobenzene | -- | 20 U | 20 U |
| 1,4-Dichlorobenzene | -- | 20 U | 20 U |
| Benzyl Alcohol | -- | 20 U | 20 U |
| 1,2-Dichlorobenzene | -- | 20 U | 20 U |
| 2-Methylphenol | -- | 20 U | 20 U |
| bis(2-chloroisopropyl)Ether | -- | 20 U | 20 U |
| 4-Methylphenol | -- | 20 U | 20 U |
| N-Nitroso-Di-n-Propylamine | -- | 20 U | 20 U |
| Hexachloroethane | -- | 20 U | 20 U |
| Nitrobenzene | -- | 20 U | 20 U |
| Isophorone | -- | 20 U | 20 U |
| 2-Nitrophenol | -- | 20 U | 20 U |
| 2,4-Dimethylphenol | -- | 20 U | 20 U |
| bis(2-Chloroethoxy)methane | -- | 20 U | 20 U |
| 2,4-Dichlorophenol | -- | 20 U | 20 U |
| Benzoic Acid | -- | 100 U | 100 U |
| 1,2,4-Trichlorobenzene | -- | 20 U | 20 U |
| Naphthalene | -- | 20 U | 20 U |
| 4-Chloroaniline | -- | 20 U | 20 U |
| Hexachlorobutadiene | -- | 20 U | 20 U |
| 4-Chloro-3-Methylphenol | -- | 20 U | 20 U |
| 2-Methylnaphthalene | -- | 20 U | 20 U |
| Hexachlorocyclopentadiene | -- | 20 U | 20 U |
| 2,4,6-Trichlorophenol | -- | 20 U | 20 U |
| 2,4,5-Trichlorophenol | -- | 100 U | 100 U |
| 2-Chloronaphthalene | -- | 20 U | 20 U |
| 2-Nitroaniline | -- | 100 U | 100 U |
| Dimethylphthalate | -- | 20 U | 20 U |
| Acenaphthylene | -- | 20 U | 20 U |
| 2,6-Dinitrotoluene | -- | 20 U | 20 U |
| 3-Nitroaniline | -- | 100 U | 100 U |
| Acenaphthene | -- | 20 U | 20 U |
| 2,4-Dinitrophenol | -- | 100 U | 100 U |
| Dibenzofuran | -- | 20 U | 20 U |
| 4-Nitrophenol | -- | 100 U | 100 U |
| 2,4-Dinitrotoluene | -- | 20 U | 20 U |
| Fluorene | -- | 20 U | 20 U |
| Diethylphthalate | -- | 20 U | 20 U |
| 4-Chlorophenyl-phenylether | -- | 20 U | 20 U |
| 4-Nitroaniline | -- | 100 U | 100 U |
| 4,6-Dinitro-2-Methylphenol | -- | 100 U | 100 U |
| N-Nitrosodiphenylamine | -- | 20 U | 20 U |
| 4-Bromophenyl-phenylether | -- | 20 U | 20 U |
| Hexachlorobenzene | -- | 20 U | 20 U |
| Pentachlorophenol | -- | 100 U | 100 U |
| Phenanthrene | -- | 20 U | 20 U |
| Anthracene | -- | 20 U | 20 U |
| Di-n-Butylphthalate | -- | 20 U | 20 U |
| Fluoranthene | -- | 20 U | 20 U |
| Pyrene | -- | 20 U | 20 U |
| Butylbenzylphthalate | -- | 20 U | 20 U |
| Benzo(a)Anthracene | -- | 20 U | 20 U |
| 3,3'-Dichlorobenzidine | -- | 40 U | 40 U |
| Chrysene | -- | 20 U | 20 U |
| bis(2-Ethylhexyl)Phthalate | -- | 20 U | 20 U |
| Di-n-octylphthalate | -- | 20 U | 20 U |
| Benzo(b)Fluoranthene | -- | 20 U | 20 U |
| Benzo(k)Fluoranthene | -- | 20 U | 20 U |
| Benzo(a)Pyrene | -- | 20 U | 20 U |
| Indeno(1,2,3-cd)Pyrene | -- | 20 U | 20 U |
| Dibenz(a,h)Anthracene | -- | 20 U | 20 U |
| Benzo(g,h,i)Perylene | -- | 20 U | 20 U |

IANG SITES 1 AND 2 TRIP/FIELD/

| | | | | |
|---|---|---|---|---|
| Client's ID: | | IANG-1<br>RB-5 | IANG-2<br>FB-1<br>(TAP) | IANG-2<br>FB-1<br>(DIUF) |
| Date Sampled: | | 15-Aug-90 | 30-Jul-90 | 30-Jul-90 |
| Lab ID: | | 2169-09 | -- | -- |
| Matrix: | | Water | Water | Water |

Volatile Organics (ug/l)

| | | | | |
|---|---|---|---|---|
| DATE ANALYZED | 90 | ---- | --- | ---- |
| Benzene | U | -- | -- | -- |
| Ethyl Benzene | U | -- | -- | -- |
| Toluene | U | -- | -- | -- |
| Xylenes | U | -- | -- | -- |
| Chlorobenzene | U | -- | -- | -- |
| 1,2 Dichlorobenzene | U | -- | -- | -- |
| 1,3 Dichlorobenzene | U | -- | -- | -- |
| 1,4 Dichlorobenzene | U | -- | -- | -- |

Semi-Volatile Organics (ug/l)

| | | | | |
|---|---|---|---|---|
| DATE ANALYZED | 90 | ---- | --- | ---- |
| N-Nitroso-Dimethylamine | U | -- | -- | -- |
| Phenol | U | -- | -- | -- |
| bis(2-Chloroethyl)ether | U | -- | -- | -- |
| 2-Chlorophenol | U | -- | -- | -- |
| 1,3-Dichlorobenzene | U | -- | -- | -- |
| 1,4-Dichlorobenzene | U | -- | -- | -- |
| Benzyl Alcohol | U | -- | -- | -- |
| 1,2-Dichlorobenzene | U | -- | -- | -- |
| 2-Methylphenol | U | -- | -- | -- |
| bis(2-chloroisopropyl)Ether | U | -- | -- | -- |
| 4-Methylphenol | U | -- | -- | -- |
| N-Nitroso-Di-n-Propylamine | U | -- | -- | -- |
| Hexachloroethane | U | -- | -- | -- |
| Nitrobenzene | U | -- | -- | -- |
| Isophorone | U | -- | -- | -- |
| 2-Nitrophenol | U | -- | -- | -- |
| 2,4-Dimethylphenol | U | -- | -- | -- |
| bis(2-Chloroethoxy)methane | U | -- | -- | -- |
| 2,4-Dichlorophenol | U | -- | -- | -- |
| Benzoic Acid | U | -- | -- | -- |
| 1,2,4-Trichlorobenzene | U | -- | -- | -- |
| Naphthalene | U | -- | -- | -- |
| 4-Chloroaniline | U | -- | -- | -- |
| Hexachlorobutadiene | U | -- | -- | -- |
| 4-Chloro-3-Methylphenol | U | -- | -- | -- |
| 2-Methylnaphthalene | U | -- | -- | -- |
| Hexachlorocyclopentadiene | U | -- | -- | -- |
| 2,4,6-Trichlorophenol | U | -- | -- | -- |
| 2,4,5-Trichlorophenol | U | -- | -- | -- |
| 2-Chloronaphthalene | U | -- | -- | -- |
| 2-Nitroaniline | U | -- | -- | -- |
| Dimethylphthalate | U | -- | -- | -- |
| Acenaphthylene | U | -- | -- | -- |
| 2,6-Dinitrotoluene | U | -- | -- | -- |
| 3-Nitroaniline | U | -- | -- | -- |
| Acenaphthene | U | -- | -- | -- |
| 2,4-Dinitrophenol | U | -- | -- | -- |
| Dibenzofuran | U | -- | -- | -- |
| 4-Nitrophenol | U | -- | -- | -- |
| 2,4-Dinitrotoluene | U | -- | -- | -- |
| Fluorene | U | -- | -- | -- |
| Diethylphthalate | U | -- | -- | -- |
| 4-Chlorophenyl-phenylether | U | -- | -- | -- |
| 4-Nitroaniline | U | -- | -- | -- |
| 4,6-Dinitro-2-Methylphenol | U | -- | -- | -- |
| N-Nitrosodiphenylamine | U | -- | -- | -- |
| 4-Bromophenyl-phenylether | U | -- | -- | -- |
| Hexachlorobenzene | U | -- | -- | -- |
| Pentachlorophenol | U | -- | -- | -- |
| Phenanthrene | U | -- | -- | -- |
| Anthracene | U | -- | -- | -- |
| Di-n-Butylphthalate | U | -- | -- | -- |
| Fluoranthene | U | -- | -- | -- |
| Pyrene | U | -- | -- | -- |
| Butylbenzylphthalate | U | -- | -- | -- |
| Benzo(a)Anthracene | U | -- | -- | -- |
| 3,3'-Dichlorobenzidine | U | -- | -- | -- |
| Chrysene | U | -- | -- | -- |
| bis(2-Ethylhexyl)Phthalate | U | -- | -- | -- |
| Di-n-octylphthalate | U | -- | -- | -- |
| Benzo(b)Fluoranthene | U | -- | -- | -- |
| Benzo(k)Fluoranthene | U | -- | -- | -- |
| Benzo(a)Pyrene | U | -- | -- | -- |
| Indeno(1,2,3-cd)Pyrene | U | -- | -- | -- |
| Dibenz(a,h)Anthracene | U | -- | -- | -- |
| Benzo(g,h,i)Perylene | U | -- | -- | -- |

# APPENDIX I

# VALIDATION NOTES

## DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA
LAB: ESBL
DATE OF REPORT: 22 aug 90, 31 aug 90

WORK ORDER #: 2091
SAMPLE ID: IANG-1-SB1-S2 (2091-02)
ANALYSIS: V-CLP (8020 list)
PROBLEM AND ACTION: Surrogates out of limit
158 (range 30-140)
lab reextracted + analyzed
ID: 2091-02 RE
again, out: 172
ACTION: go with original data and flag everything as J

WORK ORDER #: 2125
SAMPLE ID: IANG-1-RB4 (2125-03)
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Blank Spike: PR of 2,4-DNT high
100 (limits 24-96)
Matrix Spike (2119-12)
3 PR's low, 6 RPD's high
Case Narr. states sample interference. This sample was not from our site.
Surrogate recoveries are all good.
No SV found in sample.
ACTION: None

REVIEWER: JEB
DATE: 9·13·90 / 9·14·90

DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA

LAB: ESBL

DATE OF REPORT: 22 Aug 90

WORK ORDER #: 2091

SAMPLE ID: IANG-1-SB1-S1 and S2 (2091-01 and 02)

ANALYSIS: SV-CLP

PROBLEM AND ACTION: Spiked blank: PR of PCP high 110 (limit 17-109) ∴ barely out of range. no phenols were found in the samples
ACTION: None

WORK ORDER #: 2091

SAMPLE ID: IANG-1-RB1

ANALYSIS: SV-CLP

PROBLEM AND ACTION: Spiked blank: PR of PCP high, 106 (limit 9-103)
Matrix spike on 2079-04: 4 RPD high.
limits were not exceeded by much, no SV in sample
ACTION: None

REVIEWER: JEB
DATE: 9·13·90

DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA

LAB: ESBL

DATE OF REPORT: 31 aug 90

WORK ORDER #: 2136

SAMPLE ID: IANG-1-SB6/MW5-S1 and S2 (2136-05 and 06)

ANALYSIS: SV-CLP

PROBLEM AND ACTION: phthalates found in samples
Method blank. 160 J Di,n-b-p
2136-05 has 180 J Di,n-b-p
2136-06 has 130 J Di,e-p
both common lab contaminants
within 10X amount found in
method blank/or detection limit.
ACTION: flag both as U and
raise to CRQL

WORK ORDER #: 2136

SAMPLE ID: IANG-1-RB5 and FB1 (DIUF) (2136-0 and 01)

ANALYSIS: SV-CLP

PROBLEM AND ACTION: Blank Spike: PR of 2-4-DNT high
100 (limits 24-96)
Matrix Spike: (2119-12)
3 PR low, 6 RPD out
Case Narr. states sample
interference - this sample was
not from our site.
Since blank spike not far out +
Surrogates OK. ⇒ No Action.
+ no SV in
Samples

REVIEWER: JEB
DATE: 9.17.90

DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA

LAB: ESBL

DATE OF REPORT: 12 Sep 90

WORK ORDER #: 2169

SAMPLE ID: Defueling Pit Soil (2169-07)

ANALYSIS: V- 8020

PROBLEM AND ACTION: Matrix Spike
PR of CB high on MS and MSD
Blank Spike OK. MS/MSD was done on our sample. no CBs were found in the sample + since PR was high, quant. limits are conservative.
ACTION: None

WORK ORDER #: 2169

SAMPLE ID: all water samples

ANALYSIS: SV -CLP

PROBLEM AND ACTION: Surrogates outside of acceptable limits.
Lab reextracted when there was sufficient sample.
No blanks were outside criteria. soil surr. good
Each sample will be discussed separately.

1090DPC/D76a-16#

REVIEWER: JEB

DATE: 9.24.90

# DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA

LAB: ESBL

DATE OF REPORT: 12 Sep 90

WORK ORDER #: 2169

SAMPLE ID: Defueling Pit Water (2169-01)

ANALYSIS: SV-CLP

PROBLEM AND ACTION: Surrogates out!

2169-01 E 2 BN high

2169-01 RE all OK but out of HT by 1 day.

01E : 13 J 2,4 DMP

01RE : 10 J 2,4 DMP

ACTION: HT not grossly missed, go with reextract data and flag results as estimated (J).

WORK ORDER #: 2169

SAMPLE ID: IANG-1-MW5 (2169-02)

ANALYSIS: SV-CLP

PROBLEM AND ACTION: Surrogates out!

2169-02E 2 BN high

2169-02 RE : 1 BN high 3 A low (<10%) and out of HT

neither have hits.

ACTION: Go with original data and flag BN fraction as UJ

REVIEWER: JEB

DATE: 9.24.90

## DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA
LAB: ESBL
DATE OF REPORT: 12 SEP 90

WORK ORDER #: 2169
SAMPLE ID: IANG-1-MW6 (2169-03)
IANG-1-MW8 (2169-05)
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Surrogates out!
For both samples: 3 BNs high.
no extracts due to lack of sample
Action: flag all BN with J

WORK ORDER #: 2169
SAMPLE ID: IANG-1-MW9 (2169-06 K)
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Surrogates out!
one BN high
Action: None

REVIEWER: JEB
DATE: 9.24.90

## DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA
LAB: ESBL
DATE OF REPORT: 12 SEP 90

WORK ORDER #: 2169
SAMPLE ID: 2169-06 L MS, 2169 L MS RE
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Surrogates out!
-06 L MS 2 acids low (0)
-06 MS RE 1 acid low

ACTION: go with reextract

WORK ORDER #: 2169
SAMPLE ID: 2169-06 N MSD
-06 MSD RE
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Surrogates out!
-06 N MSD 2 BN high
-06 MSD RE 3 acids low (0)

ACTION: go with original MSD

REVIEWER: JEB
DATE: 9.24.90

DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA
LAB: ESBL
DATE OF REPORT: 12 SEP 90

WORK ORDER #: 2169
SAMPLE ID: IANG-1-MW7 (2169-10)
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Surrogates out!

2169-10E 2 BN low (1 $<$ 10%)
2 A low (both $<$10%)
2169-10RE 3 A low (all $<$ 10%)
also out of HT.
all results are nondetect
ACTION: use 1st extract, flag as unusable (R)

WORK ORDER #: 2169
SAMPLE ID: FUELING PIT SOIL (2169-07)
ANALYSIS: SV-CLP
PROBLEM AND ACTION: phthalate found in sample. BEHP at 200 J ug/kg. DBP found in method blank. Since BEHP is low + no reason to believe it actually is present - prob. is lab contamination
ACTION: flag as U~~J~~

REVIEWER: JEB
DATE: 9.24.90

## DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA
LAB: ESBL
DATE OF REPORT: 12 SEP 90

WORK ORDER #: 2169
SAMPLE ID: 2169 - 06
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Matrix Spike on this sample was done on orig. extract 2169-06K and reextract 2169-06 due to poor surrogate recovery. Both 2169-06K and 06 have problems which reflect the surrogate recovery problems. Since blank spike was acceptable (see below) seems like a matrix problem + not a lab control problem. ACTION: None

WORK ORDER #: 2169
SAMPLE ID: MWBNA 900828
ANALYSIS: SV-CLP
PROBLEM AND ACTION: Blank Spike
1 PR high 101% limit (23-97%)
since this is barely out of range,
no cresols found in samples,
ACTION: None

REVIEWER: JEB
DATE: 9.24.90

DATA VALIDATION NOTES

SITE: IANG, SERGEANT BLUFF, IOWA

LAB: ESBL

DATE OF REPORT: 12 Sep 90

WORK ORDER #: 2195

SAMPLE ID: IANG-1-FB2 (D F) (2195-01)

ANALYSIS: SV

PROBLEM AND ACTION: Blank Spike
PR of 4-C-m-c was 101
(limit 23-97)
MSD was ok
All surrogates good
No SV in samples
Action: None

WORK ORDER #:

SAMPLE ID:

ANALYSIS:

PROBLEM AND ACTION:

REVIEWER: JEB
DATE: 9.24.90

# APPENDIX J

# CHAIN-OF-CUSTODY

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO.: CL390.05

PROJECT NAME/LOCATION: SIOUX CITY / IANG

SAMPLERS: (Signature) Patrick J McDonnell / Tom Benson

| STA. NO. | DATE | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | TPH (418.01) | CLP (SEMI VOL) | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/15 | 1200 | | X | IANG-1-MW-7 | 2 | X | | | | | | |
| | ↓ | ↓ | | ~~X~~ | ~~IANG-1-FB-2 (TPH)~~ | ~~2~~ | ~~X~~ | | | | | | |
| | | | | X | IANG-1-RB-5 | 2 | X | | | | | | |
| | | | | | ~~IANG-1~~ PJM 8/15/90 | | | | | | | | |
| | | | | X | IANG-1-MW-7 | 2 | | X | | | | | |
| | | | | ~~X~~ | ~~IANG-1-FB-2 (TAR)~~ | ~~2~~ | | ~~X~~ | | | | | |
| | | | | X | IANG-1-RB-5 | 2 | | X | | | | | |
| | | | | X | IANG-1-MW-2 | 2 | X | | | | | | |
| | | | | X | IANG-1-MW-2 | 2 | | X | | | | | |

J-2

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
| Patrick J McDonnell | 8/15/90 1700 | | | | |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| | | | | | |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks | Shp- receipt # 7566477740 |

Distribution: Original Accompanies Shipment. Copy returned with Report.

ENGINEERING SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO.: CL 740 05

PROJECT NAME/LOCATION: SIOUX CITY / IANG

SAMPLERS: (Signature) Patrick J. McDonnell / [illegible]

| STA. NO. | DATE | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | TPH (418.01) | CLP (SEMI [illegible]) | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/5 | 1200 | | ☒ | IANG-1-MW-8 | 2 | ☒ | | | | | | |
| | ↓ | ↓ | | ☒ | IANG-1-MW-9 | 4 | ☒ | | | | | | USED FOR MS + MSD |
| | | | | ☒ | IANG-1-MW-8 | 2 | | ☒ | | | | | |
| | ↓ | ↓ | | ☒ | IANG-1-MW-9 | 4 | | ☒ | | | | | USED FOR MS + MSD |
| | | | | | | | | | | | | | |
| | ↓ | 1700 | | ☒ | IANG-1-[illegible] Pit | 1 | ☒ | ☒ | | | | | SOIL |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature) Patrick J. McDonnell | Date / Time 8/15/90 1700 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks SHIPPING RECEIPT # 756697736 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

2091

| | | |
|---|---|---|
| PROJ. NO.<br>CL390.05 | PROJECT NAME/LOCATION<br>SIOUX CITY - IANG | |
| SAMPLERS: *(Signature)*<br>Tom Benson | | |

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | Volatiles (8020) | TPH (418.1) | Semi Vols. (CLP) | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/31 | | | ✓ | IANG-1-SB-1-S1 | ·1 | ✓ | | | | | | 2091-01A |
| | | | | ✓ | " | ·1 | | ✓ | ✓ | | | | SOIL 2091-01B |
| | | | | ✓ | IANG-1-SB-1-S2 | ·1 | ✓ | | | | | | -02A |
| | | | | ✓ | " | ·1 | | ✓ | ✓ | | | | -02B |
| | | | | | IANG-1-RB-1 | :2 | ✓ | | | | | | -03A, B |
| J-4 | | | | | " w/ HCl | :2 | | ✓ | | | | | -03C, D |
| | | | | | " | :2 | | | ✓ | | | | -03E, F |
| | | | | | | | | | | | | | WATER |
| | 7/10 | | | | 1A (Trip) | ·1 | ✓ | | | | | | -04A |
| | | | | | 1B (Trip) | ·1 | ✓ | | | | | | -04B |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | Samples 7°C & Intact |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: *(Signature)*<br>Tom Benson | Date / Time<br>8/1/90 5:30 | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received for Laboratory by: *(Signature)* | Date / Time<br>8/2/90 1040 | Remarks Ship. Bill receipt # 7566978193 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

2125

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJ. NO.<br>CL390.05 | PROJECT NAME/LOCATION<br>SIOUX CITY - IANG | | | | | NO. OF CON-TAINERS | PARAMETER | | | | | | REMARKS |
| SAMPLERS: (Signature)<br>Tom Benson | | | | | | | Volatiles 8020 | TPH (418.1) | CLP (Semi-Vols) | | | | |
| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | | | | | | | | |
| | 8/6 | 1200 | | ✓ | IANG-1-SB-3/MW-2-S1 | 1 | ✓ | | | | | | 2125-05A |
| | ↓ | ↓ | | ✓ | " | 1 | | ✓ | ✓ | | | | -05B |
| | ↓ | ↓ | | ✓ | IANG-1-SB-3/MW-2-S2 | 1 | ✓ | | | | | | SOIL -06A |
| | ↓ | ↓ | | ✓ | " | 1 | | ✓ | ✓ | | | | -06B |
| | ↓ | 1700 | | | IANG-1-RB-3 | 2 | ✓ | | | | | | -07A,B |
| | ↓ | ↓ | | | " | 2 | | ✓ | | -07C,D | | | WATER (Hold for conversation |
| | ↓ | ↓ | | | " | 2 | | | ✓ | -07E,F | | | Tom Benson/Mike Cohen AVC |
| | 8/7 | 1200 | | ✓ | IANG-1-SB-4/MW-3-S1 | 1 | ✓ | | | | | | 2125-08A |
| | ↓ | ↓ | | ✓ | " | 1 | | ✓ | ✓ | | | | SOIL -08B |
| | ↓ | ↓ | | ✓ | IANG-1-SB-4/MW-3-S2 | 1 | ✓ | | | | | | -09A |
| | ↓ | ↓ | | ✓ | " | 1 | | ✓ | ✓ | | | | -09B |
| | ↓ | ↓ | | | 2-A TRIP BLANK | 1 | ✓ | | | | | | WATER -10A |
| | ↓ | ↓ | | | 2-B " " | 1 | ✓ | | | | | | WATER -10B |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | Samples 5°C + Intact |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature)<br>Tom Benson | Date / Time<br>8/8/90 1700 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time<br>8/9/90 1030 | Remarks Shp. receipt # 544043471 | |

Distribution: Original Accompanies Shipment, Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

2125

PROJ. NO. CL390.05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS: *(Signature)* Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | Volatiles (8020) | TPH (418.1) | CLP Semi-Volatiles | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/8 | 1115 | | ✓ | IANG-1-SB-5/MW-4-S1 | 1 | ✓ | | | | | | 2125-01A |
| | | | | ✓ | " | 1 | | ✓ | ✓ | | | | 2125-01B |
| | | | | ✓ | IANG-1-SB-5/MW-4-S2 | 1 | ✓ | | | | | | SOIL -02A |
| | | ↓ | | ✓ | " | 1 | | ✓ | ✓ | | | | -02B |
| | | 1200 | | | IANG-1-RB-4 | 2 | ✓ | | | | | | -03A, B |
| | | | | | " | 2 | | ✓ | | | | | -03C, D |
| | | | | | " | 2 | | | ✓ | | | | WATER -03E, F |
| | | | | | 3-A TRIP BLANK | 1 | ✓ | | | | | | -04A |
| | ↓ | ↓ | | | 3-B " " | 1 | ✓ | | | | | | -04B |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | Samples 5°c + Intact |

| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
|---|---|---|---|---|---|
| Tom Benson | 8/8/90 1700 | | | | |

| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
|---|---|---|---|---|---|
| | | | | | |

| Relinquished by: *(Signature)* | Date / Time | Received for Laboratory by: *(Signature)* | Date / Time | Remarks |
|---|---|---|---|---|
| | | | 8/9/90 1030 | Shp. receipt # 54406434 82 |

Distribution Original Accompanies Shipment. Copy returned with Report.

RB2 + FB1 tap
on hold. 8020
run inadvert.
not charged

**ENGINEERING-SCIENCE**

1810 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

jcB 10.12.90

2136

| PROJ. NO. | PROJECT NAME/LOCATION |
|---|---|
| CL390.05 | SIOUX CITY - IANG |

SAMPLERS: (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | Volatiles (8020) | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/10 | 1200 | | | IANG-1-RB-2 | 2 | ✓ | | | | | | 2136-02A,B |
| | 8/12 | 1200 | | | IANG-1-RB-5 | 2 | ✓ | | | | | | 2136-03A,B |
| | 8/12 | 1200 | | | IANG-1-FB-1 (DIUF) | 2 | ✓ | | | | | | -01A,B |
| | 8/12 | 1200 | | | IANG-1-FB-1 (TAP) | 2 | ✓ | | | | | | 2136-04A,B |
| | 8/9 | 1100 | | ✓ | IANG-1-SB-6/MW-5-S1 | 1 | ✓ | | | | | | -05A |
| | 8/9 | 1100 | | ✓ | IANG-1-SB-6/MW-5-S2 | 1 | ✓ | | | | | | -06A |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S1 | 1 | ✓ | | | | | | -07A |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S2 | 1 | ✓ | | | | | | -08A |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S2-D | 1 | ✓ | | | 2136-09A | | | Used for MS + MSD |
| | 8/11 | 1200 | | ✓ | IANG-1-SB-8/MW-7-S1 | 1 | ✓ | | | | | | -10A |
| | 8/11 | 1200 | | ✓ | IANG-1-SB-8/MW-7-S2 | 1 | ✓ | | | | | | -11A |
| | 8/11 | 1800 | | ✓ | IANG-1-SB-9/MW-8-S1 | 1 | ✓ | | | | | | -12A |
| | 8/12 | 0900 | | ✓ | IANG-1-SB-9/MW-8-S2 | 1 | ✓ | | | | | | -13A |
| | 8/12 | 0900 | | ✓ | IANG-1-SB-9/MW-8-S2-D | 1 | ✓ | | | | | | -14A |
| | 8/12 | 1830 | | | 4-A / 4-B TRIP BLANKS | 2 | ✓ | | | | | | -15A,B |

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
| Tom Benson | 8/12/90 | | | | |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| | | | | | |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time 8/14/90 1030 | Remarks shp. receipt # 544064 3025<br>samples 5°C + Intact | |

Original Accompanies Sh . Co rnod Report

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

2136

| PROJ. NO. | PROJECT NAME/LOCATION |
|---|---|
| CL390.05 | SIOUX CITY – IANG |

SAMPLERS: (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | PARAMETER: TPH (418.1) | PARAMETER: Semi-Vol. (CLP) | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/9 | 1100 | | ✓ | IANG-1-SB-6/MW-5-S1 | 1 | ✓ | ✓ | | | | | 2136-05B,D |
| | 8/9 | 1100 | | ✓ | IANG-1-SB-6/MW-5-S2 | 1 | ✓ | ✓ | | | | | 2136-06B,E |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S1 | 1 | ✓ | ✓ | | | | | -07B,D |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S2 | 1 | ✓ | ✓ | | | | | -08B,E |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-S2-D | 1 | ✓ | ✓ | 2136-09B | | | | Used For MS + MSD |
| | 8/11 | 1200 | | ✓ | IANG-1-SB-8/MW-7-S1 | 1 | ✓ | ✓ | | | | | 2136-10B |
| | 8/11 | 1200 | | ✓ | IANG-1-SB-8/MW-7-S2 | 1 | ✓ | ✓ | | | | | 2136-11B |
| | 8/11 | 1800 | | ✓ | IANG-1SB-9/MW-8-S1 | 1 | ✓ | ✓ | | | | | 2136-12B |
| | 8/12 | 0900 | | ✓ | IANG-1-SB-9/MW-8-S2 | 1 | ✓ | ✓ | | | | | 2136-13B |
| | 8/12 | 0900 | | ✓ | IANG-1-SB-9/MW-8-S2-D | 1 | ✓ | ✓ | | | | | 2136-14B |
| | | | | | | | | | | | | | |
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| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
| Tom Benson | 8/ | | | | |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
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| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks | |
| | | | 8/14/90 1030 | slp. receipt # 0440643025 | |

anies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

Water

2136

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJ. NO.<br>CL390,05 | PROJECT NAME/LOCATION<br>SIOUX CITY - IANG | | | | | NO. OF CONTAINERS | PARAMETER | | | | | | REMARKS |
| SAMPLERS: (Signature)<br>Tom Benson | | | | | | | | | | | | | |
| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | | TPH (418.1) | Semi-VOTs. (CLP) | | | | | |
| | 8/10 | 1200 | | | IANG-1-RB-2 | 2 | ✓ | | | | | | 2136-02C,D |
| | 8/10 | 1200 | | | IANG-1-RB-2 | 2 | | ✓ | | | | | -02E,F |
| | 8/12 | 1200 | | | IANG-1-RB-5 | 2 | ✓ | | | | | | -03C,D |
| | 8/12 | 1200 | | | IANG-1-RB-5 | 2 | | ✓ | | | | | -03E,F |
| | 8/12 | 1200 | | | IANG-1-FB-1 (TAP) | 2 | ✓ | | | | | | -04C,D |
| | 8/12 | 1200 | | | IANG-1-FB-1 (TAP) | 2 | | ✓ | | | | | -04E,F |
| | | | | | | | | | | | | | |
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|---|---|---|---|---|---|
| Relinquished by: (Signature)<br>Tom Benson | Date / Time<br>8/13/90 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time<br>8/14/90 1030 | Remarks<br>shp. receipt # 5410642756 | |

Dist[illegible]n Ori[illegible]ccom[illegible]s Shi[illegible]. Co[illegible]rned with Report

## ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record Water 2136

| PROJ. NO. | PROJECT NAME/LOCATION |
|---|---|
| CL380.05 | SIOUX CITY - IANG |

SAMPLERS: *(Signature)* Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | TPH (418.1) | HSL VOCs (CLP) | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/12 | 1200 | | | IANG-1-FB-1 (DIUF) | 2 | ✓ | | | | | | 2136-01C, 01D |
| | 8/12 | 1200 | | | IANG-1-FB-1 (DIUF) | 2 | | ✓ | | | | | 2136-01E, 01F |
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| | | | | | | | | | | | | | Samples 5°C + Intact |

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|---|---|---|---|---|---|
| Relinquished by: *(Signature)*<br>Tom Benson | Date / Time<br>8/13/90 | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received for Laboratory by: *(Signature)* | Date / Time<br>8/14/90 1030 | Remarks<br>skp. receipt # 7566877471 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

2169

# CHAIN OF CUSTODY RECORD

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Proj. No.** CL390.65 | **Project Name** Sioux City / IANG | | | | | **NO. OF CON- TAINERS** | Vols. 8020 | TPH. (418.1) | SV (8270) | | | **REMARKS** |
| **SAMPLERS (Signature)** John McDonnell / Tom Benson | | | | | | | | | | | | |
| **STA. NO.** | **DATE** | **TIME** | | | **STATION LOCATION** | | | | | | | |
| | 8/15- | 1700 | | | IANG-1- Defueling Pit (Water) | 2-VOAS<br>4-1L-amber | 2 | 2 | 2 | | | 2169-01A,B,C,D,E,F |
| | | 1200 | | | IANG-1- MW5 | 2-VOAS<br>4-1L-amber | 2 | 2 | 2 | | | 2169-02A,B,C,D,E,F |
| | | | | | -1- MW6 | 2 VOAS<br>4-1L-amber | 2 | 2 | 2 | | | -03A,B,C,D,E,F |
| | | | | | Trip Blank | VA + Si | 2 | | | | | -04A,B |
| | | | | | -1- MW8 | 2 VOAS<br>4-1L-amber | 2 | 2 | 2 | | | -05A,B,C,D,E,F |
| | | | | | -1- MW9 Use for MS + MSD | 6 VOAS<br>8-1L-amber | 6 | 4 | 4 | | | -06A,B,C,D,E,F,G,H,I,J,K,L,M,N. |
| | | | | | IANG-1-Defueling Pit (Soil) | 1-4-oz<br>1-16-oz | 1 | 1 | 1 | | | -07A,B |
| | | | | | -1- MW2 (Water | 2-VOAS<br>4-1L-amber | 2 | 2 | 2 | | | -08A,B,C,D,E,F |
| | | | | | -1- ~~MW5~~ RB5 | 2-VOAS<br>4-1L-amber | 2 | 2 | 2 | | | -09A,B,C,D,E,F |
| | | | | | -1- MW7 | 2-VOAS<br>4-1L-amber | 2 | 2 | 2 | | | -10A,B,C,D,E,F |
| | | | | | | | | | | | | |
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| **Relinquished by: (Signature)** | **Date/Time** | **Received by: (Signature)** | **Relinquished by: (Signature)** | **Date/Time** | **Received by: (Signature)** |
| **Relinquished by: (Signature)** | **Date/Time** | **Received by: (Signature)** | **Relinquished by: (Signature)** | **Date/Time** | **Received by: (Signature)** |
| **Relinquished by: (Signature)** | **Date/Time** | **Received for Laboratory by: (Signature)** | **Date/Time** 8/17/90 1700 | **Remarks** Samples 7°C + Intact | |

[illegible] Ori[illegible] Acc[illegible]les [illegible]ment[illegible]y to C[illegible]dinator Field Files

J-11

# ENGINEERING-SCIENCE

19110 WILLAWEN ROAD SUITE 301, CLEVELAND OHIO 44119 • 216/486-9005

un of Custody Record

2169

ROJ. NO.: 310.05

PROJECT NAME/LOCATION: SIOUX CITY / IANG

MPLERS: (Signature) Patrick J McDonnell / Tom Benson

| A NO. | DATE | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | VOLATILES 8020 | TPH (418.1) | CLP (SEMI VOL) | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/15 | 1200 | | X | ~~IANG-1-MW-2~~ | 2 | | X | | | | | ~~2169-0~~ |
| | ↓ | ↓ | | X | IANG-1-MW-5 | 2 | | X | | | | | 2169-02C, D |
| | | | | X | IANG-1-MW-6 | 2 | | X | | | | | -03C, D |
| | | | | X | ~~IANG-1-MW-2D~~ [illegible] | ~~2~~ | X | | | | | | CORRECT (IGNORE LINE) |
| | | | | X | IANG-1-MW-5 | 2 | X | | | | | | 2169-02A, B |
| | | | | X | IANG-1-MW-6 | 2 | X | | | | | | -03A, B |
| | | | | X | IANG-1-MW-7 | 2 | X | | | | | | -04A, B |
| | | | | X | IANG-1-MW-8 | 2 | X | | | | | | -05A, B |
| | | | | X | IANG-1-MW-9 | 6 | X | | | | | | USED FOR MS + MSD 06A, E, G, D<br>06G, F, G |
| | | | | X | IANG-1-RB-5 | 2 | X | | | | | | |
| | | | | X | ~~IANG-1-FB-2 (TAP)~~ | 2 | X | | | | | | |
| | | | | X | ~~IANG-1-MW-2~~ | 2 | | | X | | | | |
| | | | | X | IANG-1-MW-5 | 2 | | | X | | | | 2169-02B, F |
| | | | | X | IANG-1-MW-6 | 2 | | | X | | | | -03B, F |
| | | | | | 5A / 5B TRIP BLANK | 2 | X | | | | | | |

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
| Patrick J McDonnell | 8/15/90 1700 | | | | |

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
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| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks |
|---|---|---|---|---|
| | | | 8/17/90 1740 | SHIPPING RECEIPT # 7566977751 |

Distribution: Original Accompanies Shipment; Copy returned with Report.

# ENGINEERING-SCIENCE

[illegible] ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

in-of Custody Record

2169

PROJ. NO.: 390.05

PROJECT NAME/LOCATION: SIOUX CITY / IANG

AMPLERS: (Signature) Patrick J McDonnell / Tom Benson

| A. NO. | DATE | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | VOLATILES 8020 | TPH (418.1) | CLP (SEMI VOL.) | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/15 | 1200 | | X | ~~IANG-1-MW-2~~ | 2 | | X | | | | | ~~2169-0~~ |
| | ↓ | ↓ | | X | IANG-1-MW-5 | 2 | | X | | | | | 2169-02C, D |
| | ↓ | ↓ | | X | IANG-1-MW-6 | 2 | | X | | | | | -03C, D |
| | ↓ | ↓ | | X | ~~IANG-1-MW-2~~ | ~~2~~ | X | | | | | | CORRECT (IGNORE LINE) |
| | ↓ | ↓ | | X | IANG-1-MW-5 | 2 | X | | | | | | 2169-02A, B |
| | ↓ | ↓ | | X | IANG-1-MW-6 | 2 | X | | | | | | -03A, B |
| | ↓ | ↓ | | X | IANG-1-MW-7 | 2 | X | | | | | | -04A, B |
| | ↓ | ↓ | | X | IANG-1-MW-8 | 2 | X | | | | | | -05A, B |
| | ↓ | ↓ | | X | IANG-1-MW-9 | 6 | X | | | | | | USED FOR MS + MSD 06A, B, C, D 06E, F, G |
| | ↓ | ↓ | | X | IANG-1-RB-5 | 2 | X | | | | | | |
| | ↓ | ↓ | | X | ~~IANG-1-FB-2 (TAP)~~ | 2 | X | | | | | | |
| | ↓ | ↓ | | X | ~~IANG-1-MW-2~~ | 2 | | | X | | | | |
| | ↓ | ↓ | | X | IANG-1-MW-5 | 2 | | | X | | | | 2169-02E, F |
| | ↓ | ↓ | | X | IANG-1-MW-6 | 2 | | | X | | | | -03E, F |
| | | | | | 5A / 5B TRIP BLANK | 2 | X | | | | | | |

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
|---|---|---|---|---|---|
| Patrick J McDonnell | 8/15/90 1700 | | | | |

| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
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| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks |
|---|---|---|---|---|
| | | | 8/17/90 1140 | SHIPPING RECEIPT # 756697775 1 |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE, INC.

2169

## CHAIN OF CUSTODY RECORD

| | |
|---|---|
| Proj. No. CL310.05 | Project Name SIOUX CITY - IANG |
| SAMPLERS (Signature) Tom Benson / Pat McDonnell | |

| STA. NO. | DATE 90 | TIME | | Grab | STATION LOCATION | NO. OF CONTAINERS | Volatiles 8020 | TPH (418.1) | TCLP semi-vols | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/15 | 1700 | | X | IANG-1-Defueling Pit | 2 | X | | | | | 2169-01A,B |
| | | | | X | " | 2 | | X | | | | WATER 2169-01C,D |
| | | | | X | " | 2 | | | X | | | -01E,F |
| | | | | X | IANG-1-Defueling Pit (soil) | 1 | X | | | | | SOIL |
| | | | | | | | | | | | | Samples 7°C + Intact |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature) Tom Benson | Date/Time 8/15/90 1800 | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received for Laboratory by: (Signature) | Date/Time 8/17/90 1700 | Remarks SHIPPING RECEIPT # 7[illegible]69[illegible]77[illegible] | |

Distribution: Original Accompanies Shipment; Copy to Coordinators Field Files

# ENGINEERING-SCIENCE, INC.

2195

## CHAIN OF CUSTODY RECORD

Proj. No. CL390.06

Project Name SIOUX CITY - IANG

SAMPLERS (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | | Grab | STATION LOCATION | NO. OF CONTAINERS | Volatiles 8020 | TPH (418.1) | Semi-Vols (CLP) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 8/23 | 1030 | | X | IANG-1-FB-2 (DIUF) | 2 | X | | | 2195-01A, B |
| | " | " | | X | " | 2 | | X | | -01C, D |
| | " | " | | X | " | 2 | | | X | -01E, F |
| | | | | | | | | | | |
| | | | | | Trip Blank 6A | 1 | X | | | -02A |
| | | | | | " " 6B | 1 | X | | | -02B |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature) Tom Benson | Date/Time 8/23/90 1200 | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received for Laboratory by: (Signature) | Date/Time 8/24/90 1030 | Remarks ship. receipt # 756975905<br>Samples 4°C + Intact | |

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

| | |
|---|---|
| PROJ. NO. CL370.05 | PROJECT NAME/LOCATION Sioux City - IANG |
| SAMPLERS: (Signature) Tom Benson | |

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | Gross Alpha/Beta | Radium 226 | Radium 228 | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/27 | | | | IANG-2-RB-1 Gross Alpha/Beta | 2 | ✓ | | | | | | Water |
| | " | | | | IANG-2-RB-1 Radium 226, 228 | 2 | | ✓ | ✓ | | | | |
| | " | | | ✓ | IANG-2-SB-1-S1 | 1 | ✓ | ✓ | ✓ | | | | Soil |
| | 7/28 | | | | IANG-2-RB-2 Gross Alpha/Beta | 2 | ✓ | | | | | | water |
| | " | | | | IANG-2-RB-2 Radium 226, 228 | 2 | | ✓ | ✓ | | | | |
| | " | | | ✓ | IANG-2-SB-1-S2 | 1 | ✓ | ✓ | ✓ | | | | soil |
| | " | | | ✓ | IANG-2-SB-1-S3 | 1 | ✓ | ✓ | ✓ | | | | |
| | " | | | ✓ | IANG-2-SB-2-S1 | 1 | ✓ | ✓ | ✓ | | | | |
| | " | | | ✓ | IANG-2-SB-2-S2 | 1 | ✓ | ✓ | ✓ | | | | soil |
| | " | | | ✓ | IANG-2-SB-2-S3 | 1 | ✓ | ✓ | ✓ | | | | |
| | 7/29 | | | | IANG-2-RB-3 Gross Alpha/Beta | 2 | ✓ | | | | | | Water |
| | " | | | | IANG-2-RB-3 Radium 226, 228 | 2 | | ✓ | ✓ | | | | |
| | " | | | | IANG-2-SB-3-S1 | 1 ~~2~~ | ✓ | ✓ | ✓ | | | | |
| | " | | | | IANG-2-SB-3-S2 | 1 | ✓ | ✓ | ✓ | | | | Soil |
| | " | | | | IANG-2-SB-3-S3<br>IANG-2-SB-3-S4 | 1<br>1 | ✓<br>✓ | ✓<br>✓ | ✓<br>✓ | | | | |

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|---|---|---|---|---|---|
| Relinquished by: (Signature) Tom Benson | Date / Time 7/31/90 6:00 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) Kathy Ortiz | Date / Time 8-2-90 10:10 | Remarks Ship. Bill receipt # 7564873204 | |

Distribution: Original Accompanies Shipment, Copy returned with Report.

ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD. SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

## Chain-of Custody Record

PROJ. NO. CL390.05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS: (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | GROSS ALPHA/BETA | RADIUM 226 | RADIUM 228 | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/30 | | | ✓ | IANG-2-SB-4-S1 | 1 | ✓ | ✓ | ✓ | | | | Soil |
| | | | | ✓ | IANG-2-SB-4-S2 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-SB-4-S3 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-SB-5-S1 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-SB-5-S2 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-SB-5-S3 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-SB-5-S4 | 1 | ✓ | ✓ | ✓ | | | | |
| | | | | | IANG-2-RB-4 Gross Alpha/Beta | 2 | ✓ | | | | | | Water |
| | ↓ | | | | IANG-2-RB-4 Radium 226, 228 | 2 | | ✓ | ✓ | | | | |
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| Relinquished by: (Signature)<br>Tom Benson | Date / Time<br>7/31/90 6:00 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time<br>8/2/90 10:00 | Remarks Ship · Bill receipt # 7566 97 8215 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO. CC 390.05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS: *(Signature)* Tom Benson

| | | | | | | | PARAMETER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | Gross Alpha/Beta | Radium 226 | Radium 228 | | | | REMARKS |
| | 1/20 | 1700 | | | IANG-2-FB-1 (TAP) | 2 | ✓ | | | | | | |
| | ↓ | 1700 | | | " | 2 | | ✓ | ✓ | | | | |
| | ↓ | 1730 | | | IANG-2-FB-1 (DIUF) | 2 | ✓ | | | | | | |
| | ↓ | 1730 | | | " | | | ✓ | ✓ | | | | |
| | ↓ | 1730 | | | IANG-2-BENTONITE | 1 | ✓ | ✓ | ✓ | | | | |
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| Relinquished by: *(Signature)* Tom Benson | Date / Time 7/31/90 6:00 | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| Relinquished by: *(Signature)* | Date / Time | Received for Laboratory by: *(Signature)* | Date / Time 8-2-90 10:00 | Remarks Shp. Bill receipt # 7564978326 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO. CL390.05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | GROSS ALPHA/BETA | RADIUM 226 | RADIUM 228 | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-BR1 | 1 | ✓ | ✓ | ✓ | | | | |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-BR2 | 1 | ✓ | ✓ | ✓ | | | | |
| | 8/10 | 1200 | | ✓ | IANG-1-SB-7/MW-6-BR2-D | 1 | ✓ | ✓ | ✓ | | | | |
| | 8/10 | 1200 | | | IANG-1-RB-2 (Gross Alpha/Beta) | 2 | ✓ | | | | | | |
| | 8/10 | 1200 | | | IANG-1-RB-2 (Radium 226, 228) | 2 | | ✓ | ✓ | | | | |
| | 8/12 | 1200 | | | IANG-1-FB-1 (DIUF) | 2 | ✓ | | | | | | |
| | 8/12 | 1200 | | | IANG-1-FB-1 ~~(TAP)~~ (DIUF) | 2 | | ✓ | ✓ | | | | |
| | 8/12 | 1200 | | | IANG-1-FB-1 (TAP) | 2 | ✓ | | | | | | |
| | 8/12 | 1200 | | | IANG-1-FB-1 (TAP) | 2 | | ✓ | ✓ | | | | |
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| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
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| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
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| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time | Remarks |
|---|---|---|---|---|
| | | | 8/14/90 9:00 | Ship receipt # 5440643014 |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO. CL 390 05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS: (Signature) Pat McDonnell / Tom Benson

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CONTAINERS | GROSS ALPHA/BETA | RADIUM 226 | RADIUM 228 | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/14 | 1700 | | X | IANG-2-MW-1 | 2 | ✓ | | | | | | |
| | | | | X | " | 2 | | ✓ | ✓ | | | | |
| | | | | X | IANG-2-MW-2 | 2 | ✓ | | | | | | |
| | | | | X | " | 2 | | ✓ | ✓ | | | | |
| | | | | X | IANG-2-MW-3 | 2 | ✓ | | | | | | |
| | | | | X | " | 2 | | ✓ | ✓ | | | | |
| | | | | X | IANG-2-MW-4 | 2 | ✓ | | | | | | |
| | | | | X | " | 2 | | ✓ | ✓ | | | | |
| | | | | X | IANG-2-MW-5 | 2 | ✓ | | | | | | |
| | ↓ | ↓ | | | " | 2 | | ✓ | ✓ | | | | |
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| Relinquished by: (Signature)<br>Patrick J. McDonnell | Date / Time<br>8/14/90 1700 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature)<br>Kathy | Date / Time<br>8-15-90 9:30 | Remarks<br>SHIPPING RECEIPT #<br>5440643401 | |

Distribution: Original Accompanies Shipment, Copy returned with Report

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

Chain-of Custody Record

PROJ. NO. CL390.05

PROJECT NAME/LOCATION SIOUX CITY - IANG

SAMPLERS: (Signature) Tom Denson / Patrick J. McDonnell

| STA. NO. | DATE 90 | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | Gross Alpha/Beta | Radium 226 | Radium 228 | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3/14 | 1700 | | ✓ | IANG-2-MW-6 | 2 | ✓ | | | | | | |
| | ↓ | ↓ | | ✓ | " | 2 | | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-RD-5 | 2 | ✓ | | | | | | |
| | | | | ✓ | " | 2 | | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-FB-2 (DIUF) | 2 | ✓ | | | | | | |
| | | | | ✓ | " | 2 | | ✓ | ✓ | | | | |
| | | | | ✓ | IANG-2-FB-2 (TAP) | 2 | ✓ | | | | | | |
| | ↓ | ↓ | | | " | 2 | | ✓ | ✓ | | | | |
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| Relinquished by: (Signature) Tom Denson | Date / Time 3/14/90 1700 | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received by: (Signature) | Relinquished by: (Signature) | Date / Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature) | Date / Time 3/15/90 9:30 | Remarks ship. receipt # 544064 3390 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

# ENGINEERING-SCIENCE

19101 VILLAVIEW ROAD, SUITE 301, CLEVELAND, OHIO 44119 • 216/486-9005

## Chain-of Custody Record

PROJ. NO.: [illegible]

PROJECT NAME/LOCATION: SIOUX CITY / IANG

SAMPLERS: *(Signature)* [illegible]

| STA. NO. | DATE | TIME | COMP. | GRAB. | STATION LOCATION | NO. OF CON-TAINERS | [illegible] | [illegible] | [illegible] | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [illegible] | [illegible] | | X | IANG-1-MW-6 | 2 | X | | | | | | | |
| | | \| | | X | ~~IANG-1-FB-2 (TAP)~~ | ~~2~~ | X | | | | | | | |
| | | \| | | X | IANG-1-RB-5 | 2 | X | | | | | | | |
| | | \| | | X | IANG-1-MW-10 | 2 | X | | | | | | | |
| | | \| | | X | IANG-1-MW-6 | 2 | | X | X | | | | | |
| | | \| | | X | ~~IANG-1-FB-2 (TAP)~~ | ~~2~~ | | X | X | | | | | |
| | | \| | | X | IANG-1-RB-5 | 2 | | X | X | | | | | |
| | ✓ | ↓ | | X | IANG-1-MW-10 | 2 | | X | X | | | | | |
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| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
|---|---|---|---|---|---|
| [illegible] | [illegible] 1700 | | | | |
| Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* | Relinquished by: *(Signature)* | Date / Time | Received by: *(Signature)* |
| | | | | | |
| Relinquished by: *(Signature)* | Date / Time | Received for Laboratory by: *(Signature)* | Date / Time | Remarks | |
| | | | 8/17/90 9:30 | Shp. receipt # 7566977762 | |

Distribution Original Accompanies Shipment. Copy returned with Report.

ENGINEERING-SCIENCE, INC.

# CHAIN OF CUSTODY RECORD

Proj. No. 62390.06

Project Name SIOUX CITY - IANG

SAMPLERS (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | | Grab | STATION LOCATION | NO. OF CONTAINERS | Gross Alpha/Beta | | Radium 226 | Radium 228 | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/23 | 1200 | | X | IANG-1-FB-2 (DUP) | 2 | X | | | | | | |
| | | | | X | " | 2 | | | X | X | | | |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature)<br>Tom Benson | Date/Time<br>8/23/90 1300 | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received for Laboratory by: (Signature) | Date/Time<br>8-24 9:30 | Remarks ship. receipt # 756697553 | |

Copy to Coordinators Field

# APPENDIX K

# JP-FUEL FINGERPRINT ANALYSIS RESULTS

**ENGINEERING-SCIENCE, INC.**

BERKELEY LABORATORY
600 BANCROFT WAY
BERKELEY, CA 94710
Tel (415) 841-7353

Report Date: 09/14/90

Work Order No.:2201

Client:
Kevin Palombo
ES Cleveland/Sioux City IANG
19101 Villaview Road
Cleveland, OH. 44119

Date of Sample Receipt: 08/27/90

Your samples identified as:

JP-4 (FRESH)
JP-4 (FROM IANG1-MW-4)

were analyzed for hydrocarbon fingerprint.

The analytical reports for the samples listed above are attached.

RECEIVED
[illegible] 17 [illegible]
CLEVELAND ES

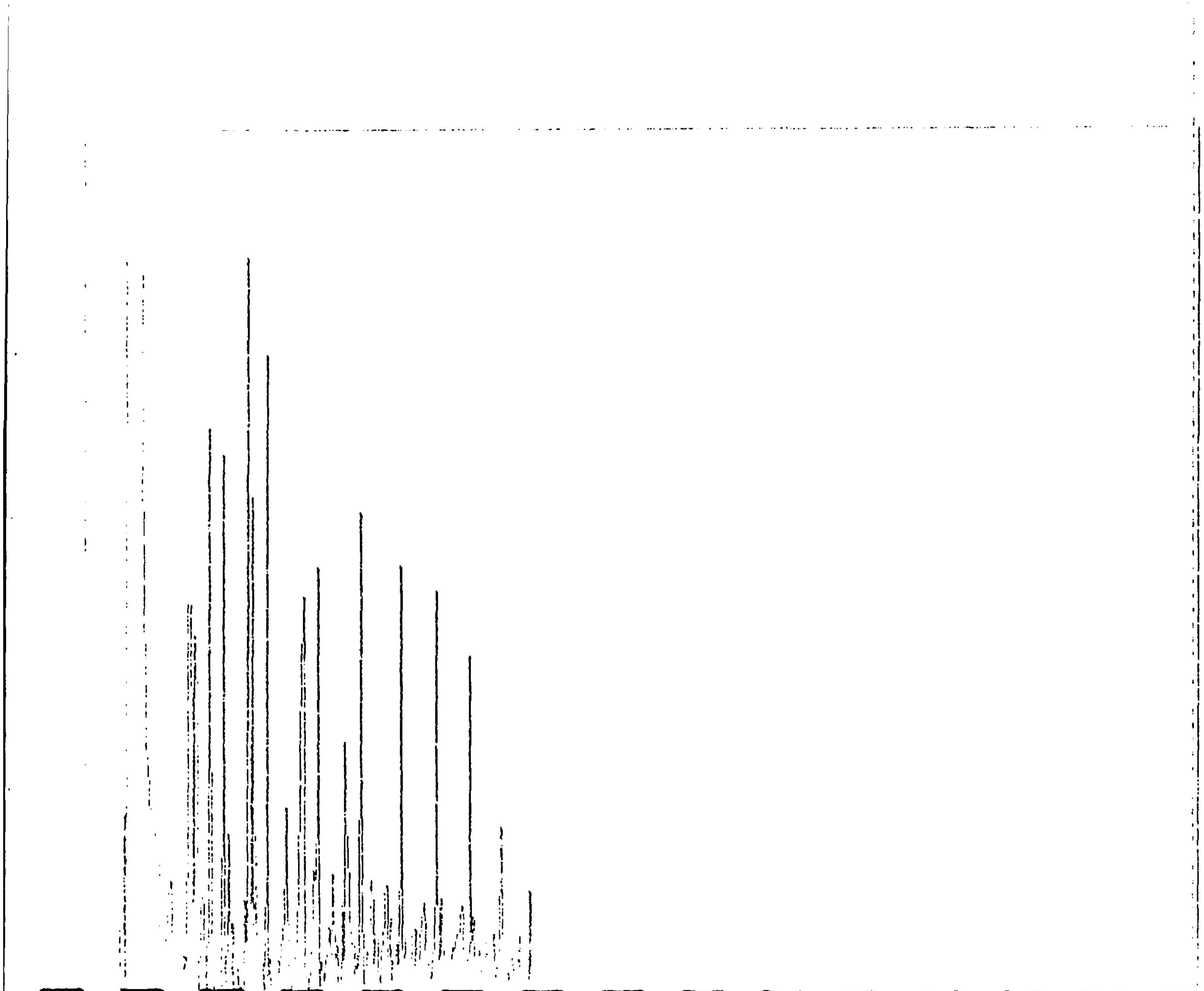
# CASE NARRATIVE
# WORK ORDER NO. 2201
# JP-4 FUEL FINGERPRINT
# METHOD MODIFIED 8015

Both samples have substantially similar characteries with regard to boiling range and carbon number, indicating that both sample and standard are likely to be from similar producer distillation cuts.

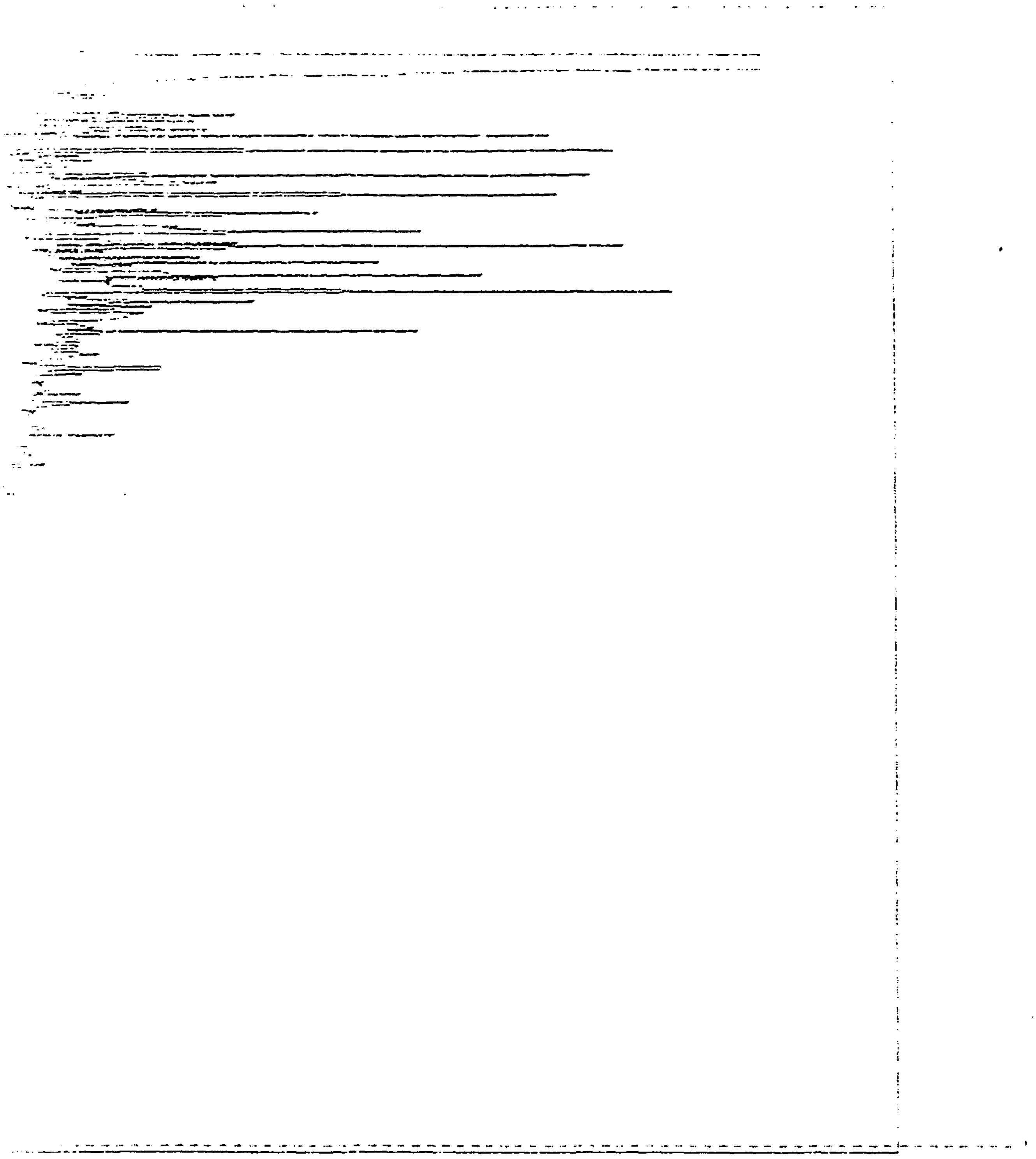
However, small differences are notable on the chromatograms regarding ratios of the major peaks, indicating that the two samples are from different manufacturing lots, and/or refineries.

Further, it is our opinion that both sample and standard can be considered essentially unweathered JP4. The standard has a slightly higher predominance of heavier constituents, giving the appearance that the "Fresh" standard material is slightly more weathered than the sample which is of course, not possible.

cn2201cn



[illegible]



```
    Sample ID:","2101-2 1/100 u/v                              "
Analysis Date:","Thu Dec 13, 1990  5:57:22 pm           "
Dilution Factor:",        1.00"
    Data File:"," OA34 DES_2201A_027.RES
 Method File:","\DATA DIESEL2504 PTH                  ","[illegible]
                                                              "
```

2201

# ENGINEERING-SCIENCE, INC.

## CHAIN OF CUSTODY RECORD

Proj. No. CL390.06

Project Name SIOUX CITY - IANG

SAMPLERS (Signature) Tom Benson

| STA. NO. | DATE 90 | TIME | | Grab | STATION LOCATION | NO. OF CONTAINERS | Hydrocarbon Fingerprint | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/23 | 1530 | | X | JP-4 (Fresh) | 1 | X | | 2201-01A | | | Unused, from Base storage. |
| | 11 | 11 | | X | JP-4 (from IANG-1-MW-4) | 1 | X | | -02A | | | Discharged to sub-surface, old. |
| | | | | | | | | | | | | Samples 9°C + Intact |

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: (Signature) Tom Benson | Date/Time 8/23/90 1530 | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) |
| Relinquished by: (Signature) | Date/Time | Received for Laboratory by: (Signature) | Date/Time 8/24/90 1100 | Remarks shp. receipt # ~~9566975972~~ 6725459915 | |

# APPENDIX L

# SAMPLE JAR DECONTAMINATION DOCUMENTATION

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

## GC ANALYTICAL REPORT
Analytical Method
PESTICIDE EPA 608

Work Order NO.: 1617

Matrix:NA

Client ID: 125 ml clear wm short 0100501B

Unit:ug/Bottle

Laboratory ID: 1617-01A

Date Analyzed:01/18/90
Date Confirmed:NA
Date Extracted:01/12/90

Dilution Factor: 1

| Compound | Result | Reporting Limit |
|---|---|---|
| Aldrin | ND | 0.004 |
| Alpha-BHC | ND | 0.003 |
| Beta-BHC | ND | 0.006 |
| Delta-BHC | ND | 0.009 |
| Gamma-BHC | ND | 0.004 |
| Chlordane | ND | 0.014 |
| 4,4'-DDD | ND | 0.011 |
| 4,4-DDE | ND | 0.004 |
| 4,4-DDT | ND | 0.012 |
| Dieldrin | ND | 0.002 |
| Endosulfan I | ND | 0.014 |
| Endosulfan II | ND | 0.004 |
| Endosulfan Sulfate | ND | 0.066 |
| Endrin | ND | 0.006 |
| Heptachlor | ND | 0.003 |
| Heptachlor Epoxide | ND | 0.083 |
| Endrin aldehyde | ND | 0.18 |
| Toxaphene | ND | 0.24 |
| PCB_1016 | ND | 0.1 |
| PCB-1221 | ND | 0.4 |
| PCB-1232 | ND | 0.3 |
| PCB-1242 | ND | 0.2 |
| PCB-1248 | ND | 0.2 |
| PCB-1254 | ND | 0.2 |
| PCB-1260 | ND | 0.2 |

ND-Not Detected
NA-Not Applicable

ANALYST: 1/23/90

GROUP LEADER: 1/23/90

ALL RESULTS ARE REPORTED AS RECEIVED

BTEX

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

# GC ANALYTICAL REPORT
Analytical Method 608

Work Order NO.: 1500

% Moisture:NA

Client ID: 0127201A 500 ML WIDE MOUTH CLEAR SHORT

MATRIX:WATER

Laboratory ID: 89100208

Unit:UG/BOTTLE

Date Extracted: 10/13/89

Date Analyzed:10/20/89

Dilution Factor: 1

Date Confirmed:NA

| Compound | Result | Reporting Limit |
|---|---|---|
| Aldrin | ND | 0.004 |
| Alpha-BHC | ND | 0.003 |
| Beta-BHC | ND | 0.006 |
| Delta-BHC | ND | 0.009 |
| Gamma-BHC | ND | 0.004 |
| Chlordane | ND | 0.014 |
| 4,4'-DDD | ND | 0.011 |
| 4,4-DDE | ND | 0.004 |
| 4,4-DDT | ND | 0.012 |
| Dieldrin | ND | 0.002 |
| Endosulfan I | ND | 0.014 |
| Endosulfan II | ND | 0.004 |
| Endosulfan Sulfate | ND | 0.066 |
| Endrin | ND | 0.006 |
| Heptachlor | ND | 0.003 |
| Heptachlor Epoxide | ND | 0.083 |
| Endrin aldehyde | ND | 0.18 |
| Toxaphene | ND | 0.24 |
| PCB_1016 | ND | 0.1 |
| PCB-1221 | ND | 0.4 |
| PCB-1232 | ND | 0.3 |
| PCB-1242 | ND | 0.2 |
| PCB-1248 | ND | 0.2 |
| PCB-1254 | ND | 0.2 |
| PCB-1260 | ND | 0.2 |

ND-Not Detected
NA-Not Applicable

ANALYST: D. Stewart

GROUP LEADER: SF
10/25/89

NOTE:

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

# GC ANALYTICAL REPORT
Analytical Method
PESTICIDE EPA 608

Work Order NO.: 1738

Matrix:NA

Client ID: 1-LITER AMBER BOTTLE 0108101B

Unit:ug/Bottle

Laboratory ID: 1738-01

Date Analyzed:04/04/90
Date Confirmed:NA
Date Extracted:03/28/90

Dilution Factor: 1

| Compound | Result | Reporting Limit |
|---|---|---|
| Aldrin | ND | 0.004 |
| Alpha-BHC | ND | 0.003 |
| Beta-BHC | ND | 0.006 |
| Delta-BHC | ND | 0.009 |
| Gamma-BHC | ND | 0.004 |
| Chlordane | ND | 0.014 |
| 4,4'-DDD | ND | 0.011 |
| 4,4'-DDE | ND | 0.004 |
| 4,4'-DDT | ND | 0.012 |
| Dieldrin | ND | 0.002 |
| Endosulfan I | ND | 0.014 |
| Endosulfan II | ND | 0.004 |
| Endosulfan Sulfate | ND | 0.066 |
| Endrin | ND | 0.006 |
| Heptachlor | ND | 0.003 |
| Heptachlor Epoxide | ND | 0.083 |
| Endrin aldehyde | ND | 0.18 |
| Toxaphene | ND | 0.24 |
| PCB_1016 | ND | 0.1 |
| PCB-1221 | ND | 0.4 |
| PCB-1232 | ND | 0.3 |
| PCB-1242 | ND | 0.2 |
| PCB-1248 | ND | 0.2 |
| PCB-1254 | ND | 0.2 |
| PCB-1260 | ND | 0.2 |

ND-Not Detected
NA-Not Applicable

ANALYST:

GROUP LEADER:

10APR90

ES-ENGINEERING-SCIENCE, INC.

600 Bancroft Way
Berkeley, CA 94710

# INORGANICS ANALYTICAL REPORT

Client: ESS
Project: Bottle Analysis
Work Order: 1851
Matrix: Bottle

| | | | | | | |
|---|---|---|---|---|---|---|
| Client's ID: | 0111301B<br>1 LITER<br>HDPE MR | 0211301B<br>250 ML<br>HDPE MR | | | | |
| Sample Date: | 04/26/90 | 04/26/90 | | | | |
| % Moisture: | NA | NA | | | | |
| Lab ID: | 1851.01<br>A | 1851.02<br>A | | | | |
| Parameter | Results | | Method | Normal Report Limit | Units | Date Analyzed |
| Arsenic | ND | ND | GF-AA | 1 | ug/bottle | 05/10/90 |
| Cadmium | ND | ND | ICP | 1 | " | 05/09/90 |
| Chromium | ND | ND | ICP | 5 | " | 05/09/90 |
| Iron | ND | ND | ICP | 5 | " | 05/09/90 |
| Lead | ND | ND | ICP | 10 | " | 05/09/90 |
| Mercury | ND | ND | CV-AA | .04 | " | 05/10/90 |
| Zinc | ND | ND | ICP | 2 | " | 05/09/90 |

ND- Not Detected

ANALYST: J. Michael

GROUP LEADER:

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

# GC ANALYTICAL REPORT
## Analytical Method
## 601 Volatile Compounds

Work Order NO.:1583

% Moisture:NA

Client ID:0134601A

Matrix:Water

Laboratory ID:1583-01

Unit:ug/bottle

Date Collected:12/13/89

Date Analyzed:12/21/89

Date Confirmed:12/21/89

Dilution Factor: 1

| Compound | Result | Reporting Limit |
|---|---|---|
| BROMODICHLOROMETHANE | ND | 0.003 |
| BROMOFORM | ND | 0.005 |
| BROMOMETHANE | ND | 0.030 |
| CARBON TETRACHLORIDE | ND | 0.003 |
| CHLOROBENZENE | ND | 0.006 |
| CHLOROETHANE | ND | 0.013 |
| 2CHLOROETHYLVINYLETHER | ND | 0.003 |
| CHLOROFORM | ND | 0.001 |
| CHLOROMETHANE | ND | 0.002 |
| DIBROMOCHLOROMETHANE | ND | 0.002 |
| 12 DICHLOROBENZENE | ND | 0.004 |
| 13 DICHLOROBENZENE | ND | 0.008 |
| 14 DICHLOROBENZENE | ND | 0.006 |
| DICHLORODIFLUOROMETHANE | ND | 0.045 |
| 11 DICHLOROETHANE | ND | 0.002 |
| 12 DICHLOROETHANE | ND | 0.001 |
| 11 DICHLOROETHENE | ND | 0.003 |
| t-12 DICHLOROETHENE | ND | 0.003 |
| 12 DICHLOROPROPANE | ND | 0.001 |
| c-13 DICHLOROPROPENE | ND | 0.009 |
| t-13 DICHLOROPROPENE | ND | 0.005 |
| METHYLENE CHLORIDE | 0.15 | 0.006 |
| 1122 TETRACHLOROETHANE | ND | 0.001 |
| TETRACHLOROETHENE | ND | 0.001 |
| 111 TRICHLOROETHANE | ND | 0.001 |
| 112 TRICHLOROETHANE | ND | 0.001 |
| TRICHLOROETHENE | ND | 0.003 |
| TRICHLOROFLUOROMETHANE | ND | 0.013 |
| VINYL CHLORIDE | ND | 0.005 |

ND-Not Detected
NA-Not Applicable

ANALYST: MW 12/27/89

GROUP LEADER: SF 12/27/89

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

## GC ANALYTICAL REPORT
Analytical Method
602 plus Xylenes

Work Order NO.:1583

% Moisture:NA

Client ID:0134601A

Matrix:Water

Laboratory ID:1583-01

Unit:ug/bottle

Date Collected:12/13/89

Date Analyzed:12/21/89

Date Confirmed:NA

Dilution Factor: 1

| Compound | Result | Reporting Limit |
|---|---|---|
| Benzene | ND | 0.005 |
| Chlorobenzene | ND | 0.005 |
| 1,2 Dichlorobenzene | ND | 0.010 |
| 1,3 Dichlorobenzene | ND | 0.010 |
| 1,4 Dichlorobenzene | ND | 0.008 |
| Ethyl Benzene | ND | 0.005 |
| Toluene | ND | 0.005 |
| Xylenes (total) | ND | 0.010 |

ND-Not Detected
NA-Not Applicable

ANALYST: MW
12/27/89

GROUP LEADER: SF
12/27/89

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way
Berkeley,CA 94710

# GC ANALYTICAL REPORT
## Analytical Method
## PESTICIDE EPA 608

Work Order NO.: 2060

Unit:ug/Bottle

Client ID: 125 ML CLEAR WMS
0120101B

Laboratory ID: 2060-1

Date Extracted:7/23/90
Date Analyzed :7/30/90
Inst. Ser. #. :EGC5-900730
Date Confirmed:NA
Inst. Ser. #. :NA

Dilution Factor: 1

| Compound | Result | Reporting Limit |
|---|---|---|
| Aldrin | ND | 0.004 |
| Alpha-BHC | ND | 0.003 |
| Beta-BHC | ND | 0.006 |
| Delta-BHC | ND | 0.009 |
| Gamma-BHC | ND | 0.004 |
| Chlordane | ND | 0.014 |
| 4,4'-DDD | ND | 0.011 |
| 4,4'-DDE | ND | 0.004 |
| 4,4'-DDT | ND | 0.012 |
| Dieldrin | ND | 0.002 |
| Endosulfan I | ND | 0.014 |
| Endosulfan II | ND | 0.004 |
| Endosulfan Sulfate | ND | 0.066 |
| Endrin | ND | 0.006 |
| Heptachlor | ND | 0.003 |
| Heptachlor Epoxide | ND | 0.083 |
| Endrin aldehyde | ND | 0.18 |
| Toxaphene | ND | 0.24 |
| PCB_1016 | ND | 0.1 |
| PCB-1221 | ND | 0.4 |
| PCB-1232 | ND | 0.3 |
| PCB-1242 | ND | 0.2 |
| PCB-1248 | ND | 0.2 |
| PCB-1254 | ND | 0.2 |
| PCB-1260 | ND | 0.2 |

ND-Not Detected
NA-Not Applicable

ANALYST:

GROUP LEADER:

**SEQUOIA ANALYTICAL**
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

REC'D JUN 15 1990

| | | | | |
|---|---|---|---|---|
| ESS, Inc. | Client Project ID: | | Sampled: | May 23, 19 |
| 9061 San Leandro St. | Sample Descript: | 500 ml Clear WM Short | Received: | May 23, 19 |
| Oakland, CA 94693 | Analysis Method: | EPA 8080 | Extracted: | Jun 8, 19 |
| Attention: Matthew Macy | Lab Number: | 005-3691 | Analyzed: | Jun 8, 19 |
| | | 01142016 | Reported: | Jun 13, 19 |

## ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 8080)

| Analyte | Detection Limit µg/L | Sample Results µg/L |
|---|---|---|
| Aldrin | 0.10 | N.D. |
| alpha-BHC | 0.050 | N.D. |
| beta-BHC | 0.050 | N.D. |
| delta-BHC | 0.050 | N.D. |
| gamma-BHC (Lindane) | 0.40 | N.D. |
| Chlordane | 0.15 | N.D. |
| 4,4'-DDD | 0.10 | N.D. |
| 4,4'-DDE | 0.050 | N.D. |
| 4,4'-DDT | 0.10 | N.D. |
| Dieldrin | 0.10 | N.D. |
| Endosulfan I | 0.15 | N.D. |
| Endosulfan II | 0.10 | N.D. |
| Endosulfan sulfate | 0.75 | N.D. |
| Endrin | 0.010 | N.D. |
| Endrin aldehyde | 0.25 | N.D. |
| Heptachlor | 0.10 | N.D. |
| Heptachlor expoxide | 0.10 | N.D. |
| Methoxychlor | 10 | N.D. |
| Toxaphene | 0.50 | N.D. |
| PCB-1016 | 1.0 | N.D. |
| PCB-1221 | 1.0 | N.D. |
| PCB-1232 | 1.0 | N.D. |
| PCB-1242 | 1.0 | N.D. |
| PCB-1248 | 1.0 | N.D. |
| PCB-1254 | 1.0 | N.D. |
| PCB-1260 | 1.0 | N.D. |

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Victor P. Menon
Project Manager